



COMBATING TERRORISM TECHNICAL SUPPORT OFFICE

2015 REVIEW BOOK

"...WE STAND UNITED WITH PEOPLE AROUND THE WORLD WHO HAVE BEEN TARGETED BY TERRORISTS -- FROM A SCHOOL IN PAKISTAN TO THE STREETS OF PARIS. WE WILL CONTINUE TO HUNT DOWN TERRORISTS AND DISMANTLE THEIR NETWORKS..."

President Barrack Obama, State of the Union Address, Jan 20, 2015

The United States' commitment to combating terrorism is unwavering, even as terrorist threats become more diverse, complex, and challenging. In support of the Technical Support Working Group (TSWG), the Combating Terrorism Technical Support Office (CTTSO) develops technologies to strengthen the abilities of operators, analysts, law enforcement, and first responders to fight terrorists, protect our people, and respond to attacks. The growth of the Islamic State of Iraq and the Levant (ISIL) in 2015 underscored the need to concentrate national and international efforts to combat terrorism.

The history of interagency and international cooperation that defines the success of the TSWG cuts across all of the instruments of national security ensuring that, in instances where technology can make the difference, it will be developed and provided rapidly. CTTSO, in managing the TSWG, remains an ever-evolving organizational model for how "whole-of-government" efforts can adapt and be conducted in an inclusive forum to achieve quick and decisive results.

This review book provides a small snapshot of CTTSO's activities in 2015. Each section describes subgroup focus areas, members, successes, and a glimpse of our ongoing projects.





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U.S. Army photo by Maj. Randall Stillinger

COMBATING TERRORISM TECHNICAL SUPPORT OFFICE

MISSION

The mission of the Combating Terrorism Technical Support Office (CTTSO) is to identify and develop capabilities to combat terrorism and irregular adversaries and to deliver these capabilities to Department of Defense (DoD) components and interagency partners through rapid research and development, advanced studies and technical innovation, and provision of support to U.S. military operations.



History and Organization

The Assistant Secretary of Defense for Special Operations/Low-Intensity Conflict (ASD SO/LIC) established CTTSO in 1999 to consolidate its research and development programs previously administered by the Office of the Assistant Secretary of Defense (Command, Control, Communications, and Intelligence). The research and development effort that supports the interagency, Technical Support Working Group (TSWG), was the first program to transition to CTTSO.

The Explosive Ordnance Disposal/Low-Intensity Conflict (EOD/LIC) Program, which develops advanced technologies for Joint Service EOD and Special Operations Forces (SOF) missions, transitioned in 2001. In 2007, the Irregular Warfare Support (IWS) Program was initiated to satisfy a growing need to improve the capacity of the United States to counter insurgencies and fight an irregular war. In FY16, portions of the EOD/LIC and IWS Programs that support the CTTSO mission were transitioned to TSWG under the Improvised Device Defeat/Explosives Countermeasures and Irregular Warfare and Evolving Threats Subgroups, respectively.



CTTSO and Other Agencies

CTTSO is charged with providing a forum for interagency and international users to discuss mission requirements to combat terrorism, prioritize these requirements, fund and manage solutions, and deliver capabilities. CTTSO accomplishes these objectives through rapid prototyping of novel solutions developed and field tested before the traditional acquisition systems are fully engaged. This low-risk approach encourages interdepartmental and interagency collaboration, thereby reducing duplication, eliminating capability gaps, and stretching development dollars.

CTTSO accomplishes its mission in three ways. First, CTTSO takes operational requirements from warfighters, incorporates policy priorities of the Department of Defense (DoD) civilian leadership¹, and rapidly identifies,

¹Applicable policy guidance includes Presidential National Security Strategy, Defense Strategic Guidance, and any guidance or instructions issued by the ASD SO/LIC.

develops, and delivers advanced capabilities for Special Operations Forces and General Purpose Forces to improve the capacity of the DoD to combat terrorism and irregular adversaries. Second, CTTSO collaborates with and supports related requirements of non-DoD U.S. government agencies and state/local/tribal governments to understand those users' priorities and requirements to share expertise, and to develop mutually beneficial capabilities. Third, CTTSO works with partner country ministries of defense under bilateral arrangements to conduct cooperative research and development, which allows the U.S. DoD to leverage foreign experience, expertise, and resources in the fight against terrorists and their infrastructure.

Technology Transition

Technology transition is the process of taking a technology from the developmental and prototype phase to production and deployment by the end user community. Transition success is achieved when research and development products have evolved to the commercial market and/or have been inserted into government acquisition programs and can be easily and continuously obtained by the combating terrorism community. The path from the research and development phase to transition success can be challenging, and it is the mission of the Technology Transition program at CTTSO to help overcome transition challenges to ensure success for the developers and end users. The Technology Transition program at CTTSO works with internal program managers, external government agencies, end users, industry, and developers to overcome any barriers that may prohibit the successful transition of CTTSO technologies.

Planning for technology transition starts at the beginning of the CTTSO business cycle and continues throughout the lifecycle of the program. In order to increase the likelihood of transition success, Technology Transition Plans are developed to provide a framework for how the technology will transition to the commercial market and/or government acquisition. Topics discussed in the Technology Transition Plan include:

- The capability gap addressed by the development of the technology;
- Identifying customers and defining the market size;
- Understanding and managing intellectual property and data rights;
- Production strategies, including partnering, investment capital, and licensing;
- Commercialization and affordability;
- Environment, safety, and regulatory issues;
- Security and export control provisions;
- Test and evaluation planning and independent operational testing; and
- Operational suitability and operational support planning.

The keys to accelerating the complicated process of moving many prototypes to production includes having a disciplined process, available assistance, and teamwork among the project manager, technology transition managers, and developers. Additional information is available at the Technology Transition section of the CTTSO website, <http://www.cttso.gov>.

Innovation

In the current budget environment of focusing on doing more with less, the need for innovation increases as we look for new ways to combat terrorism. Novel solutions come from individual entrepreneurs and tinkerers, and in order to leverage those solutions, CTTSO must constantly look for ways to actively engage them. The Innovation program at CTTSO has, at its core, the following objectives:

- Identify new ways to obtain success, rather than uncertain development, through prizes, challenges, and other rewards;
- Provide additional tools and resources to fulfill operational capability gaps;
- Increase the number and diversity of solution providers;
- Provide rapid and agile ways of doing business that lower both cost and risk.

Innovation is a model that enables Government research and development programs to identify the best solutions in the shortest amount of time possible at a lower cost. The following initiatives are underway at CTTSO to support the Innovation program.



- Rapid Innovation Fund: Facilitates the rapid insertion of innovative small business technologies into government systems or programs that meet critical national security needs.
- Challenge Driven Innovation: Crowdsourcing challenging problems to the world to provide ideas and solutions to fulfill important scientific and technical challenges.
- In-Q-Tel: Not-for-profit strategic investor who identifies, adapts, and delivers innovative commercial technology solutions to support the missions of the U.S. government.
- Laboratory Innovation Crowdsourcing (LINC): Conduit for field operators to submit their operational challenges to solvers in the U.S. Government.

International Partners

International cooperation allows CTTSO to leverage foreign experience, expertise, resources, and infrastructure in a unified approach against terrorism for the benefit of all. Therefore, in addition to its domestic interagency efforts, CTTSO directly manages bilateral agreements with five partner countries: Australia, Canada, Israel, Singapore, and the United Kingdom.

We have decades long histories of mutual support, technical cooperation, and information sharing. The rise of international terrorism began hundreds of years ago but reached new depths in the 1960s and 70s. Its subsequent proliferation in the 21st century spurred U.S. efforts to broaden the scope of cooperative activities to combat this threat to international peace and security.

From modest beginnings in the early 1990s, CTTSO's international relationships have matured and grown into wide-ranging and multifaceted programs that address a variety of technically sophisticated threat capabilities employed by terrorist groups and their state sponsors. Tactics, techniques, procedures, countermeasures, and associated equipment identified, developed, and tested under terms our expanding cooperative arrangements found their way into the inventories of U.S. and partner operators where they enhanced our respective national capabilities and permitted all partner nations to respond more effectively to the threats.

The partnerships provide insights into regional affairs, access to a broader technology base, and allows for the use of unique facilities offered by each country. Each of the agreements are 50/50 cost shared, comprised of financial and non-financial contributions, to address joint requirements, reducing duplication of efforts and scientific trial and error. Bilateral meetings are held on a regular basis to review ongoing projects and to discuss new areas of collaboration.

In addition to CTTSO's bilateral partners, CTTSO cooperates with other countries when appropriate. Dozens of operational capabilities developed with CTTSO partners are currently in service with a variety of personnel both throughout the United States and around the world.

Our international partnerships continue today and will for the foreseeable future as we strive to blunt the efforts of those who would seek to destroy our freedoms and compromise our way of life.





TECHNICAL SUPPORT WORKING GROUP

MISSION

The mission of the Technical Support Working Group (TSWG) is to identify, prioritize, and coordinate interagency and international research and development (R&D) requirements for combating terrorism. Through the Department of Defense's Combating Terrorism Technical Support Office and funding provided by other agencies, the TSWG rapidly develops technologies and equipment to meet the high-priority needs of the combating terrorism community, and addresses joint international operational requirements through cooperative R&D with major allies.



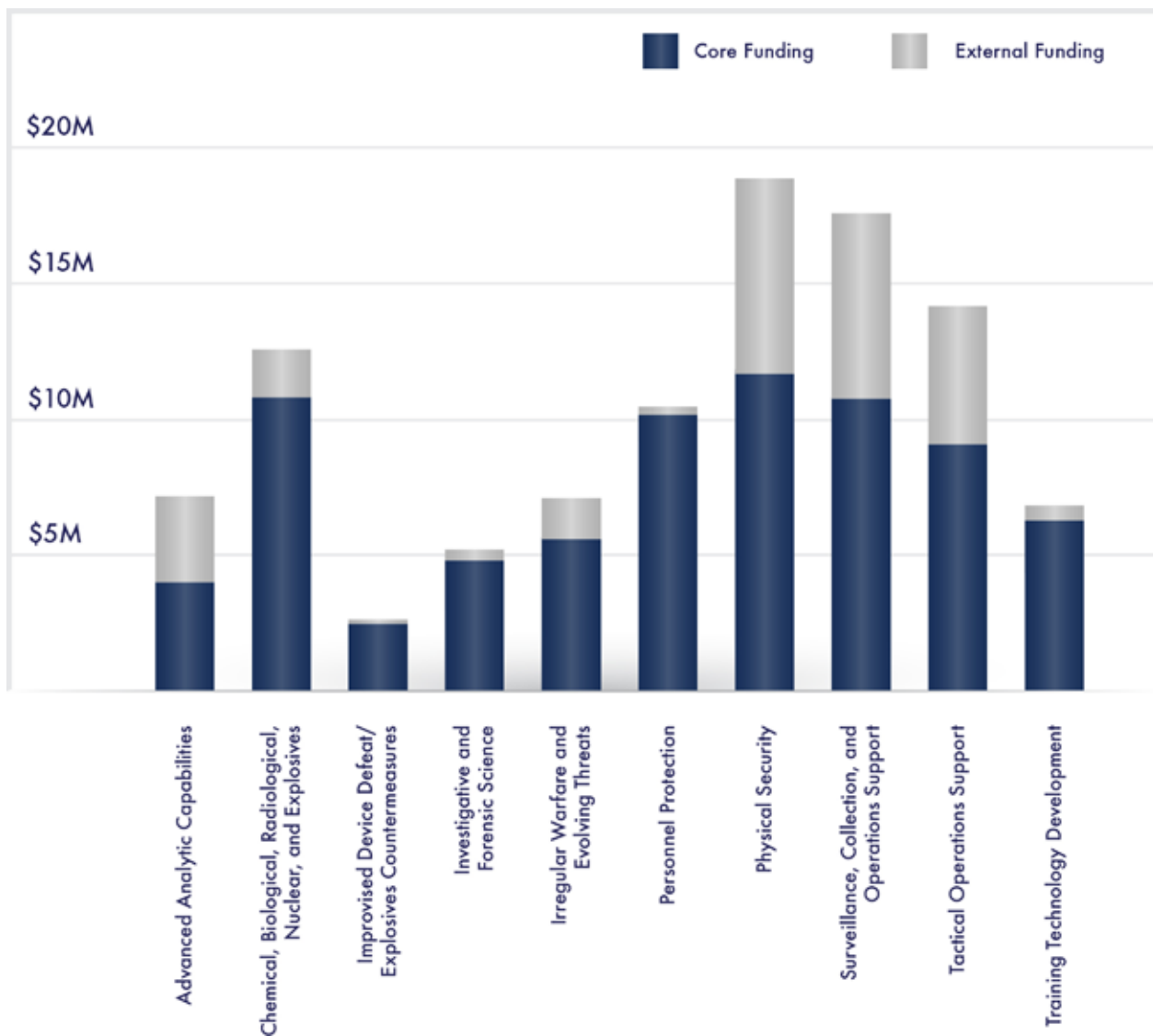
History and Organization

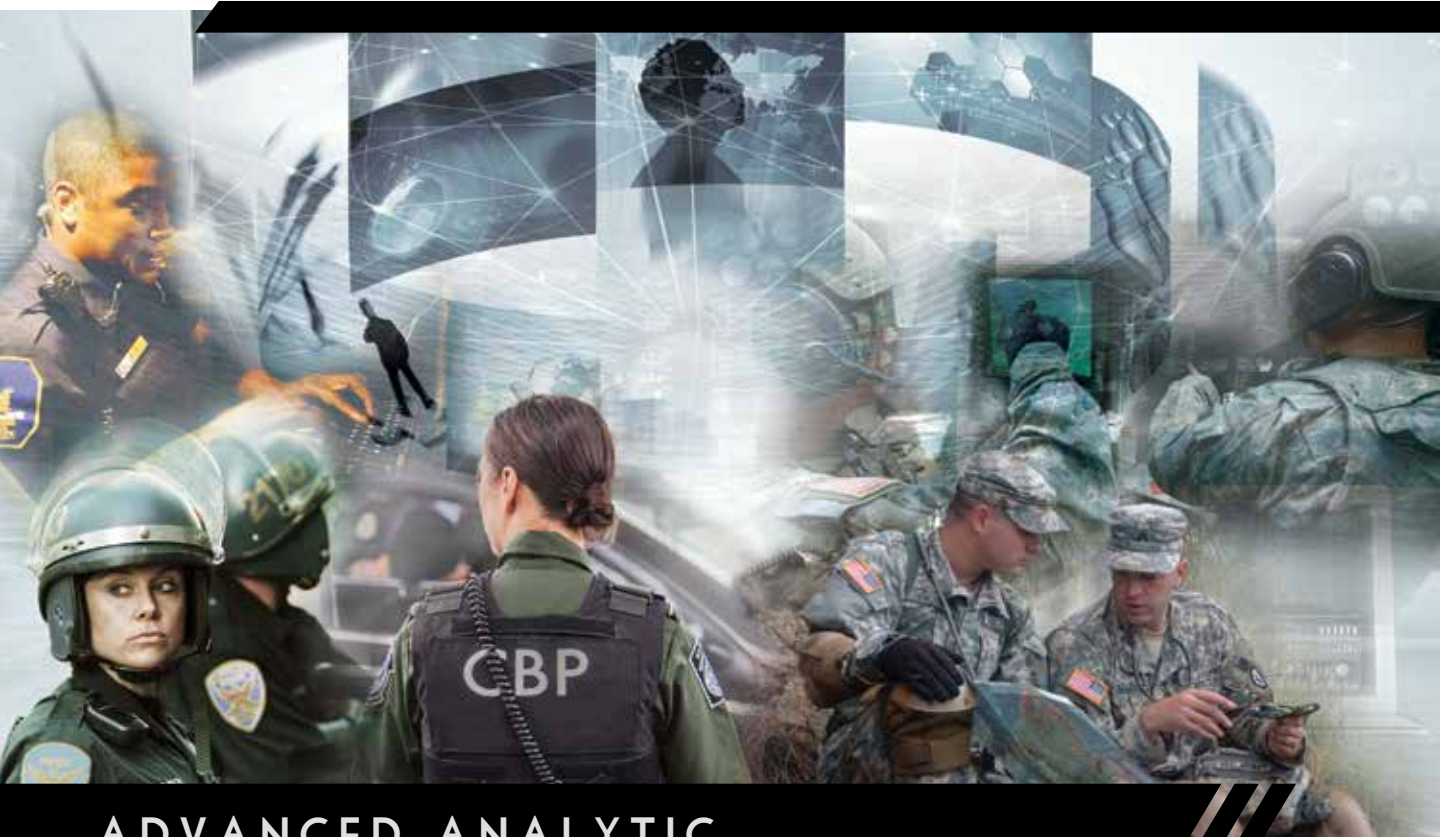
In April 1982, the National Security Decision Directive 30 assigned responsibility for the development of an overall United States policy on terrorism to the Interdepartmental Group on Terrorism (IG/T), chaired by the Department of State. TSWG was an original subgroup of the IG/T, which later became the Interagency Working Group on Counterterrorism (IWG/CT). In its February 1986 report, a Cabinet-level Task Force on Counterterrorism, led by then Vice President Bush, cited TSWG as assuring, "the development of appropriate counterterrorism technological efforts."

TSWG operates under the management and technical oversight of the Department of Defense (DoD) Assistant Secretary of Defense for Special Operations/Low-Intensity Conflict (ASD SO/LIC) and the policy oversight of the Department of State's Bureau of Counterterrorism.

TSWG's 10 subgroups are chaired by senior representatives from DoD, other federal agencies, and national organizations with special expertise in those functional areas. Chairmanship of subgroups is as indicated in the organizational chart below.



TSWG Fiscal Year 2015 Project Funding (\$106M)



ADVANCED ANALYTIC CAPABILITIES

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FOCUS AREAS

Data to Decision Systems

Develop data for decision systems that integrate and deploy predictive analytic tools and models for planning and execution of operations that include the human terrain and non-kinetic effects. Enable better and faster decisions allowing for more rapid adaptation to changes in theaters of operations.

Decision, Planning, and Analytical Tools

Develop stand-alone tools, models, and enabling technologies that provide new capabilities for improved military and interagency sense making. Successful technologies may be transitioned as an independent capability and/or integrated into larger systems.

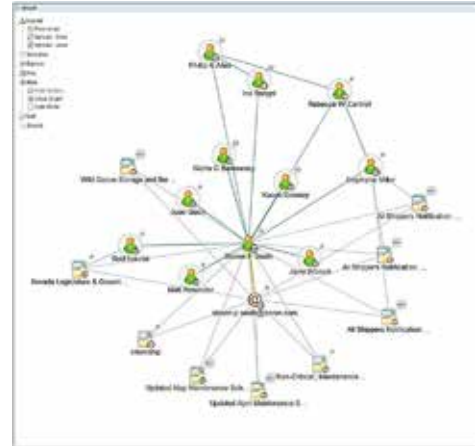
Integrated Analytic Platforms

Develop and deploy robust integrated platforms that both operators and intelligence analysts can use to synchronize operations and intelligence at the tactical level.

COMPLETED PROJECT

Guided Clustering Tool

Low-intensity conflicts such as those unfolding in Syria and Ukraine involve complex relationships among armed and civilian groups and significant individuals. In these situations, effective action by U.S. forces depends on rapid and accurate analysis of intelligence data. Traditional analysis methods that involve the pooling of contributions from several subject matter experts (SMEs) can take too long in rapidly moving engagements. The Guided Clustering Tool (GCT) rapidly assimilates and analyzes intelligence to provide a first-pass picture of the key groups and individuals, their relationships, and the significant events in which they have participated. GCT also absorbs input from SMEs to modify and enhance its automatically generated picture. The intelligence picture it creates can be used to drive both human intelligence processes and machine enabled approaches such as CTTSO's MEADE (Model Enabled Analysis, Design, and Execution). GCT automates those aspects of the intelligence assimilation process that can be defined in advance of the mission, such as identity of the key groups, people, capabilities, and relationships. GCT enables rapid situation analysis, while preserving the freedom of the analysts to steer it according to their best judgments.



CURRENT PROJECTS

Model Enabled Analysis, Design, and Execution

Historically, strategic and operational planners have struggled with creating courses of action (COAs) that result in stable and sustainable outcomes. This is a result of several factors such as collecting and assimilating the specific data needed to characterize the environment, forecasting human behavior and quantifying uncertainties, developing control strategies that mitigate the impacts of uncertainty, assessing non-kinetic outcomes, and incorporating higher order effects throughout the process. The Model Enabled Analysis, Design, and Execution (MEADE) project addresses these issues by using an engineering adaptive control approach known as Model Predictive Control (MPC). MPC is being applied to social science “best of breed” models, theories, and tools, such as ATHENA and StateSim, which are then applied to the Military Decision Making Process (MDMP).

The iterative and continuous outputs of the system are based on real-time data derived from sources ranging from battlefield reporting to social media which are displayed in a dashboard-Common Crisis Picture. This dashboard-like feature allows multiple visualizations and tools relevant to planners, decision makers, analysts, and operators. A workflow and COA builder within the Common Crisis Picture enables planners to forecast potential effects of multiple COAs to the area of operations in order to make faster and better decisions, and assist in aligning and adapting tactical and operational outcomes.

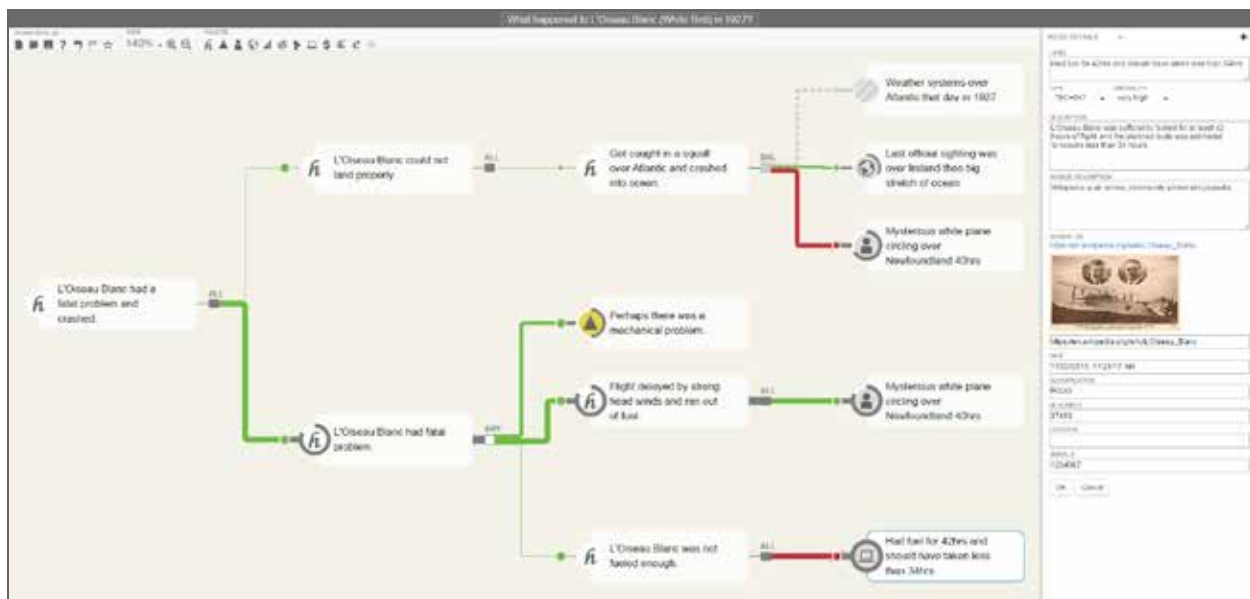




Argument Mapper Tool (Critical Thinking Tool)

CTTSO and Uncharted Software, Inc. in collaboration with George Mason University's Learning Agents Center and the Intelligence Community (IC), are applying principles of evidence-based reasoning to enhance the Argument Mapper Tool with the ability to learn reusable analytic patterns from completed analyses, store learned patterns in a common knowledge base, and apply the patterns in new scenarios.

These capabilities, combined with unique, easy-to-use visualizations and structured evidence-based reasoning techniques allow analysts to apply rigorous, evidence-based problem solving and critical thinking techniques. Visualization increases an analyst's perceptual and cognitive span, thereby increasing the speed, comprehension, and accuracy applied to complex analytical tasks. Using structured reasoning techniques for analytic questions simplifies complex problems and overcomes cognitive biases, allowing users to more easily share and collaborate on their structured reasoning. The completed system will be a web-based portal, compatible with emerging IC cloud computing, compliant with IC enterprise standards. By combining visualization with structured reasoning techniques, a user can apply visual thinking to facilitate critical thinking. The system is on track for delivery in 2016 and runs on all major browsers as either a widget within the Ozone Widget Framework or as a stand-alone web application.



Screen capture of Critical Thinking Tool used for L'Oiseau Blanc analysis.

Cognitive Counter-Improvised Explosive Device Signature System

The Cognitive Counter-Improvised Explosive Device (C-IED) Signature System (C2IS2) project is part of a larger Joint Improvised-Threat Defeat Agency (JIDA) funded effort to develop a C-IED/Attack-the-Network system. This system allows analysts and front-line personnel to analyze all elements of the network to include but not limited to finance, logistics, organization, technical and training support, and special materials needed to support an IED network, and defines the specific data requirements and expected patterns for each of the nodes. C2IS2 is a network-focused, business process model that captures all elements of the adversary's IED related activities. C2IS2



employs this model in distinct ways to develop a multi-source, fusion-focused collection plan, support signatures exploitation, create and examine hypotheses regarding what has been observed, and characterize adversarial processes in support of vulnerability assessments and predictive analysis. Another key element of C2IS2 is its comprehensive signatures database and an accompanying analysis tool suite. The database includes hundreds of thousands of IED signatures while the analysis suite provides tools needed to detect and exploit these signatures within raw collection data. Also, C2IS2 includes a comprehensive, general purpose analysis suite containing tools for spectral analysis, link/social network analysis, text-based analytics, statistical analysis, geospatial analysis, and hypothesis creation and vetting.

Cross-Agency Distributed Edge Network Analysis Platform

The Cross-Agency Distributed Edge Network Analysis (CADENA) Platform is a web-based service successfully piloted by U.S. Border Patrol sectors in the southwest and several High Intensity Drug Trafficking Areas (HIDTA) task forces as part of their Domestic Highway Enforcement (DHE) strategy. CADENA is Palantir Gotham Mobile, a suite of capabilities for integrating many different data sources for secure, collective analysis, deployed on Amazon Web Services GovCloud, a cloud computing service. CADENA was conceived to support the counterterrorism/ counternarcotic missions relevant to the flow of illicit traffic through the nations' borders, highways, and major cities. CADENA use cases and workflows have improved the speed by which unclassified data is collected by law enforcement and analyzed by operational support and investigative analysts.

Using mobile apps and leveraging available commercial devices and infrastructure, CADENA securely equips agents and officers with real-time reporting, Blue Force Tracking (BFT), data/operational/BFT visualization and situational awareness, as well as real-time reach back collaborative visualization, and data/media exchange with supporting analysts, decision makers, and other field elements. The CADENA Platform integrates data and renders it with a broad range of analytical and visualization toolsets including link-nodal, geospatial, temporal, graphical, and others.

CADENA has proven its capacity to: accelerate collaboration between operators and supporting analysts, rapidly inform investigations across jurisdictional boundaries, and deliver near real-time feedback to operators. HIDTA/ DHE are planning to transition CADENA into a national capability in FY16 while U.S. Border Patrol will continue to evaluate the results from their pilot participation and further their collaboration with HIDTA on information sharing.



Crowdsourcing at the Edge: Active and Passive Monitoring

Methodologies to conduct crowdsourcing operations in areas with limited communications have been developed combining active structured information collections and messaging combined with passive social media monitoring that include dark web tools developed by the Defense Advanced Research Projects Agency (DARPA). This system, called Pulse, is a software and hardware suite that facilitates active communication with, and crowdsourced information collected from, populations that are not easily reached using modern digital communications. Pulse includes tools developed by DARPA's Memex program that use a new search paradigm to provide fast, flexible,

and efficient access to domain-specific content as well as search interfaces that offer valuable insight into a domain that was previously unexplored. The current development combines Pulse and Memex program capabilities in a unique way to form a feedback loop between active and passive data collection schemes enabling automatic collection of information to deliver, collect, and analyze the flow of terrorist related social media, deep and rich sources, and dark web information.





Distributed Mobile Computing

The Distributed Mobile Computing (DMC) project develops a platform with the capabilities to enable secure, real-time data sharing, storage, and processing at the edge of the battlefield. The DMC system provides a secure operating environment on Android smartphones and tablets, enabling trusted routing and communications on untrusted networks. The DMC system capabilities are developed through integration of existing SAIFE® software, the GreenZone MicroCloud™ chip, and the TIPRNET®, an encrypted, cloud-based service that authenticates devices before allowing them to connect to their peers, to transform Android smartphones and tablets into secure devices for discrete communications. These capabilities and technologies address challenges related to cybersecurity and resilient networks, providing operational intelligence to users on personal electronic devices in support of special missions around the world. DMC kits are in limited operational evaluation within several DoD and law enforcement communities.

MEMBERSHIP

Intelligence Community

- Office of the Director of National Intelligence

Joint Interagency Task Force South

Kansas City Missouri Police Department

National Reconnaissance Office

U.S. Department of Defense

- Defense Intelligence Agency
- Joint Improvised-Threat Defeat Agency
- National Geospatial-Intelligence Agency

- Naval Postgraduate School
- Office of the Secretary of Defense (Rapid Fielding Office)
- Office of the Secretary of Defense for Special Operations and Low-Intensity Conflict
- Special Operations Command Central
- U.S. Army G-2, G38
- U.S. Marine Corps Intelligence Department
- U.S. Special Operations Command
 - Army Special Operations Command

U.S. Department of Homeland Security

- Customs and Border Protection, Border Patrol
- Immigration and Customs Enforcement
- Office of Intelligence and Analysis

U.S. Department of State

- Bureau of Counterterrorism
- Bureau of Near Eastern Affairs

White House

- Office of National Drug Control Policy
- Office of Science and Technology Policy



CHEMICAL, BIOLOGICAL, RADIOLOGICAL, NUCLEAR, AND EXPLOSIVES

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FOCUS AREAS

CBRNE Characterization and Attribution

Systematically investigate and identify the unique physical and chemical characteristics of CBRNE materials; develop tools to determine the origin of CBRNE agents and materials; and evaluate clandestine methods of chemical and biological agent and homemade explosives production.

Consequence Management

Develop CBRN decontamination solutions, tools, and techniques. Develop decision support tools which analyze, aggregate, and integrate multi-source data to provide enhanced on-scene situational awareness and risk assessment capabilities for CBRNE response, and develop training solutions to enhance the operational effectiveness of CBRNE operators.



Protection

Develop respiratory and dermal protective equipment to minimize exposure to CBRN materials while operationally enhancing individual performance; enhance shelter-in-place capabilities and develop materials, tools, and techniques for hydration systems in compromised environments.

Detection and Identification

Develop equipment, tools, and techniques to sample, detect, and identify trace (gases, vapors, and non-visible amounts of solid and liquid) and bulk (microgram and higher amounts of solid and liquid) amounts of CBRNE threat materials at point, proximity (inches), and standoff (meters to kilometers) distances in both fixed and on-the-move configurations.

COMPLETED PROJECTS



Biological Protective Ensemble

The Biological Protective Ensemble (BRN-94) concept was created in order to address the threat of the Ebola virus disease for Department of Defense personnel, first responders, and first receivers. The BRN-94 provides National Fire Protection Association (NFPA) 1994, Standard on Protective Ensembles for First Responders to CBRN Terrorism Incidents, Class 4 protection and NFPA 1999, Standard on Protective Clothing for Emergency Medical Operations, protection.

The BRN-94 is a breathable garment with reduced heat stress that provides viral penetration resistance and blood and body fluid penetration resistance in accordance with ASTM F1671, Standard Test Method for Resistance of Materials Used in Protective Clothing to Penetration by Blood-Borne Pathogens. The BRN-94 is made with W.L. GORE® CROSSTECH® and CHEMPAK® fabric technology and is manufactured in the USA by Blauer Manufacturing Company. These fabrics and the design of the ensemble are engineered to meet the need for more durable and simpler designed personal protective equipment for emergency medical, military, law enforcement, fire, and epidemic response personnel operating in areas with high incidents of infectious disease spread by body fluids and/or airborne particulates. The BRN-94 is commercially available for purchase through Blauer Manufacturing Company.



Configurable Portable Chemical, Biological, and Radiological Glove Box

Unknown materials suspected to be chemical and biological threat agents are first screened in the field for the presence of explosive, radioactive, and volatile materials in a portable glove box (PGB) before submission to a laboratory for further analysis. MRIGlobal developed a next generation PGB that is economical, collapsible, and has configurable service ports to allow for field screening of suspected threat agent samples. The PGB has a composite construction of plastic panels that are welded together to form gas-tight seams. It has standard service ports for connection of accessory components and analysis equipment and provides a service port kit to accommodate ports of

various sizes and types at desired locations. The add-on service ports support the connection of commercial-off-the-shelf filters allowing rapid evacuation of air from the PGB for collapse and transport. A key feature of the PGB is an alpha-permeable window that can be installed by the user in the field using a custom mount to allow for detection of alpha particles from samples of interest. Prototypes with four different zipper configurations were delivered for end user test and evaluation. The product is commercially available from MRIGlobal.

Endoscopic Chemical and Biological Collector

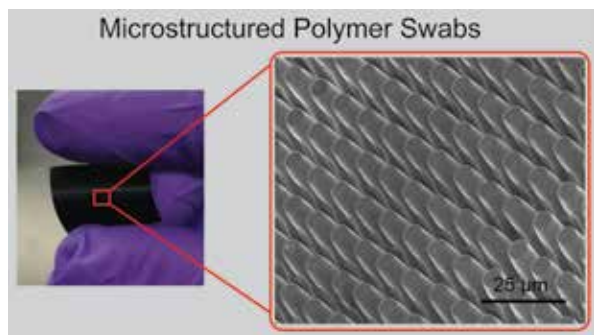
There are many operational scenarios where a chemical and biological (CB) agent may be present, but the collection methods required to determine the presence or absence of a CB agent may be difficult. Various physical barriers, such as drop mailboxes or closed rooms, may limit the ability to collect samples without opening the potentially contaminated area and exposing the surrounding area and personnel to the agent.

Bode Cellmark Forensics developed an endoscopic CB collection tool that can be manipulated into tight spaces. Through endoscopic manipulations, the material is collected using a variety of scenario-specific collection mechanisms. The operator has a choice of microfiber or macrofoam swab, custom vacuum apparatus consisting of a liquid trap and dry collection device, or a retrieval basket collection tool. The collected material is then sealed to protect sample integrity and user, and then retracted from the collection area in a manner that minimizes contamination risks to the end user. The endoscopic CB collection tool comes fitted with a custom endosheath for easy decontamination. The product is commercially available from Bode Cellmark Forensics.



Explosive Sampling Swabs

Detectors for explosive trace detection have made significant improvements in sensitivity allowing them to detect increasingly small amounts of material; however, capabilities for sampling trace amounts and delivering the sample to the detector have been stagnant. Traditionally, users sample a surface by rubbing it with a swab material that is then inserted into a detector, but studies have shown the collection efficiency of current swabs to be around thirty percent. Two efforts are underway with different approaches for developing a novel swab that will maximize the collection of trace materials and therefore increase their probability of detection.



First, Purdue University developed a polymer swab with an array of nano-scale pillars covering the surface. Through modeling and experimental validation, the height, thickness, and spacing of these pillars were optimized for maximum collection efficiency while ensuring that the sample can still be thermally desorbed off of the swab and into the detector. Second, eSpin Incorporated created chemically functionalized, electrospun nano-fibers on fabric swabs. This work focused on maximizing collection efficiency through careful down selection of commercial materials and optimization of manufacturing parameters. Although the mechanical, chemical, and thermal

properties of the swabs are different, they are both compatible with fielded ion mobility spectrometry systems and dramatically improve overall detection performance.

Filter Use Matrix

Air Purifying Respirator (APR) canister performance was previously not well understood regarding how the canisters actually perform under conditions encountered in the field. Certification testing on canisters is currently conducted at a single fixed airflow rate, temperature, relative humidity, and challenge gas concentration which are not representative of first responder use.



Canister performance (gas life) data was collected by Battelle Memorial Institute over a range of operationally relevant field conditions to characterize the effects of challenge chemical, challenge concentration, relative humidity, temperature, and breathing flow rate on canister performance. The data generated has been incorporated into an easy-to-use tool for first responders to estimate canister gas life based on user inputs at a specified field condition. The filter use matrix has been incorporated into the Emergency Response Decision Support System (ERDSS) for delivery to the emergency response community. ERDSS is a free software system provided to first responders and Government employees in the United States, Australia, and partner countries.

Emergency Response Decision Support System

Canister Life

Canister: 8

Chemical: 6

Breathing Rate: 50 Liters / minute (Intense)

Concentration: 2200 ppm

Temperature: 86 °F

Relative humidity (%): 65

Canister Life: 54 Minutes

Notes:

- 1. Please use the Respiratory Protection Tool for appropriate respiratory protection guidance.
- 2. The reaction between phosphine and carbon-based canisters produces heat.
- 3. The recommended canister life does not take into account chemical mixtures.
- 4. The tool uses experimental data. Safety factors have been accounted for in the recommended canister life.
- 5. Seek expert advice.



Flexible Powered Air Purifying Respirator

The traditional approach to Chemical, Biological, Radiological, and Nuclear (CBRN) respiratory protection has forced the operator to select a specific type of equipment to operate in a known threat scenario. A self-contained breathing apparatus (SCBA) delivers clean air in an unknown/hazardous environment; however, wear duration is typically limited to thirty minutes. The use of a CBRN powered air purifying respirator (PAPR) extends wear duration significantly, up to several hours, with less user burden; however, they are not certified for use in unknown or high risk environments. Therefore, a number of performance tradeoffs have been accepted within the specialist community, leading to a less than optimum tactical approach to missions and increased user risk.

Avon Protection Systems, Inc. developed a flexible PAPR module that provides a new generation lightweight, low profile system that is interoperable with new and existing equipment. The new design provides a user-friendly, two filter PAPR module that can be configured into SCBA mode by connecting the air supply hose and using the automatic covers to close off the filters. This modular and multifunctional design makes it easier for users to purchase and configure equipment to the level of protection and performance that a specific situation requires. The new system will be certified to National Institute for Occupational Safety and Health Statement of Standard for CBRN PAPR.

Homemade Explosive Trace Detector

Improvised explosive devices (IEDs) constructed by terrorists often contain homemade explosives (HMEs) rather than conventional high explosives due to ease of access to unrestricted starting materials. The use of readily available precursors to produce HMEs for IEDs is of great concern to the U.S. military, first responders, law enforcement, and security forces. This continual evolution of HME threats, presents an urgent need for in-field technology that provides high accuracy, low level detection with low false positives to distinguish between HME precursors and harmless compounds.



The most common field deployed explosive trace detectors at security check points are ion mobility spectrometers (IMS). Trace detection systems must adapt to meet the requirement of detecting expected future explosive threats in order to mitigate these issues. Quantum Magnetics, Inc. has developed a next generation lightweight, compact, handheld IMS explosives detector prototype capable of analyzing particulate inorganic HME threats such as nitrates and chlorates at a limit of detection of less than one microgram while retaining the ability to detect particulate commercial and military threats. The HME trace detector utilizes a proven membrane-less Ion Trap Mobility Spectrometry (ITMS™) technology. The membrane-less ITMS™ technology and new sample desorption approach provides a powerful tool for high-sensitivity detection of particulate inorganic HME threats.

Improved Liquid Tight Integrity Testing

Liquid integrity testing is used to evaluate the general design of protective clothing and ensembles for preventing the inward leakage of hazardous liquids. The previous approach for measuring liquid integrity of protective clothing and ensembles is embodied in the American Society for Testing and Materials (ASTM) F1359, Standard Test Method for Liquid Penetration Resistance of Protective Clothing for Protective Ensembles Under a Shower Spray While on a Mannequin. However, ASTM F1359 lacked consistency and reproducibility. Improved Liquid Tight Integrity testing is specified in nearly every barrier clothing standard for first responders, including those of the National Fire Protection Association and National Institute of Justice.

International Personnel Protection, Inc. developed a real-time, instrumented test methodology to replace the visual, tactile methods currently used for evaluating first responder protective ensembles for liquid protection. The evaluation of the sensor-based detection system has shown that a viable alternative approach to visual detection has been achieved. The evaluation provides the advantage of determining where and when the leakage first occurs in a garment system. Testing performed provided consistent results for test system evaluations and information on the failure modes of particular garment systems. As a result of this development effort, changes have been proposed to ASTM F1359 and are being incorporated into multiple standards.



Realistic and Adaptive Interactive Learning System for Chemical Agent Response (RAILS-CHEM)

Military and civilian responders often enter unknown environments that require split-second decisions based on instrument responses and visual cues. Spectral Labs, Inc. has developed the Realistic and Adaptive Interactive Learning System for Chemical Agent Response (RAILS-CHEM), an interactive, 3D, game-based immersive training simulator. RAILS-CHEM enables responders to control computer-simulated avatars and devices in a wide variety of realistic hazardous environments such as illicit labs or chemical warfare agent (CWA) events, which are not easily provided in classroom training situations.



RAILS-CHEM realistically models chemical agent behaviors in indoor and outdoor environments, and accurately depicts instrument response based on the environment and operations selected by the trainee. It enables instructors and administrators to easily tailor a wide range of environments (e.g., stadium events, subway stations, multi-story buildings) to their training requirements including severe threat materials, fire, smoke, and chemical weapons. For example, the CWA training module simulates a hydrogen cyanide attack in a



subway environment and challenges the player to select appropriate protective gear, look for clues that a chemical weapons attack has taken place, and use all of their simulated detectors to understand what has transpired. Non-playing characters exhibit expected symptoms and the avatar can experience health degradation based on Acute Exposure Guideline Level (AEGL) values with low health animations as well as death animations. The duration of each training module ranges from five to fifteen minutes to imitate realistic and quick response situations and to avoid scheduling impact on routine responder activities. RAILS-CHEM is available free of charge to authorized personnel and has been successfully deployed to over fifty agencies.

Realistic and Adaptive Interactive Learning System for Explosives Detection (RAILS-X)



Law enforcement, first responders, and military personnel may be responsible for detection and containment of explosive materials in a wide range of situations. Spectral Labs, Inc. is developing the Realistic and Adaptive Interactive Learning System for Explosives Detection (RAILS-X), which builds off of the RAILS-CHEM training platform, to provide an immersive 3D training simulator focused on explosives detection equipment, sampling, safety and other learning content essential to the mission. RAILS-X enables personnel to train using computer generated avatars in a wide variety of scenarios including security checkpoints, vehicle inspections, and homemade explosive (HME) labs.

The training includes instruction on the proper use of explosives trace detectors, proper techniques for maximizing the success rate of detection, and general best practice procedures. RAILS-X also integrates radiological and chemical threats to provide a robust and diverse virtual training environment combining powerful instructor tools that allow for detailed customizations of learning paths and select quantifiable learning objectives with detailed performance tracking. With added Internet based resources, RAILS-X is a complete training suite that can significantly contribute to initial and refresher training needs. Individual training modules are efficient and are designed to have a duration of five to fifteen minutes in order to imitate realistic and quick response situations and to minimize schedule impact on routine responder activities. RAILS-X is being developed with the Unity engine which has modern graphics capabilities and realistic representations of real world physics. This design approach enables RAILS-X to be deployed cross platform, including mobile platforms in future applications.

Whole Genome Amplification Methods

When utilizing genomics to investigate a sample that is suspected to contain a biological threat agent, sequence analysis offers a potentially powerful tool for bioforensics. However, this type of approach can be challenging in situations where a bioforensics sample contains an insufficient quantity of genomic material for sequence analysis. In cases where there is limited genomic material, the process of whole genome amplification (WGA) has been used to greatly amplify nucleic acid samples prior to sequence analysis, but a controlled and comprehensive study was needed to determine the limits of amplification, which is the minimum amount of starting nucleic acid that produces an amplification product in sufficient quantity to be used in sequencing analysis, and the overall quality of amplified materials. The National Bioforensic Analysis Center (NBFAC) recently completed a study of the two general classes of methods used for WGA, polymerase chain reaction (PCR), and multiple displacement amplification (MDA). Based on the results, NBFAC established the WGA best practices for PCR and MDA methods.

Effects of Decontamination Solutions on Evidence Integrity

The 1995 Tokyo sarin and 2001 U.S. anthrax attacks raised the issues of transportation, preservation, and analysis of evidence which has been contaminated with chemical and biological materials. The ideal operational procedure continues to be the safe transport of contaminated evidence to a facility where the evidence can be properly evaluated in a controlled environment without the need for decontamination; however, this is not

always a viable option due to questions regarding the integrity of samples in the courtroom. Therefore, a study was initiated between the United States, Canada, and Australia to evaluate methodologies for the decontamination of evidence to ensure that evidence quality is maintained. Decontamination processes using vaporous hydrogen peroxide, gamma irradiation, dry fogging, ozone, chlorine dioxide, MDF-500, Bioxy-S and formaldehyde were evaluated against footwear impressions, documents, fingerprints, and DNA. While the results of the interaction between each decontaminant, contaminant, and evidence type was unique, overall dry fogging with a peracetic acid solution was identified as the decontamination process that provided negligible effects on any of the evidence types. A Best Practices Field Guide has been developed with the results from all studies to provide forensic evidence collection teams with the information necessary to determine the appropriate method for decontamination of evidence.



Heat Stress Decision Support Tools



In the operational community, there is a general awareness of the thermal strain caused by hazmat personal protective equipment (PPE). However, there is a lack of reliable and practical methods of assessing thermal strain during PPE required operations. Therefore, studies were conducted to develop a numerical tool predicting the safe-working-time for users of hazmat PPE as a function of personal characteristics, workload, and thermal environment. This tool uses a combination of analytical and statistical models for determining the recommended safe-working-time. In order to test the analytical model and develop the statistical model, 290 human subject trials were carried out using NFPA 1991 and NFPA 1994 hazmat ensembles, three different workloads, and three different

thermal environments. Skin temperature, core temperature, heart rate microclimate temperature and humidity were continuously recorded; body mass was assessed; temperature sensation, thermal comfort, and ratings of perceived exertions were assessed at 10 minute intervals. The resultant data was used for machine learning and genetic programming to develop a final hybrid model referred to as Thermal Strain Companion (TSC).

The TSC has been incorporated into the Emergency Response Decision Support System (ERDSS) for delivery to the emergency response community. ERDSS is a free software system provided to first responders and Government employees in the United States, Australia, and partner countries. The use of the shortest safe-working-time calculated by this tool, when balanced with estimated available air time, is the beginning of an evidence-based approach to optimized hazmat response.

Spatially Offset Raman Spectroscopy

Spatially offset Raman spectroscopy (SORS) is an analytical technique that provides the capability to identify materials through a range of barriers and therefore allows users to identify substances inside of containers such as opaque plastic, layered mail pouches, or cardboard without having to open them. This capability significantly reduces the risk to the operator from potential chemical or explosive threats and decreases overall analysis time by no longer requiring users to sample out of the containers.

Through a joint effort with the United Kingdom's Defence Science and Technology Laboratory, Cobalt Light Systems, Ltd., located in the United Kingdom, and Ocean Optics, Inc., located in





Dunedin, FL, developed a compact, four-pound, handheld SORS device called Resolve. Resolve measures two spectral signatures, one from the surface and one from a deeper depth. By subtracting the surface measurement from the deeper spectra the system can identify a container's contents without any preexisting knowledge about the container's composition. The system is capable of both through barrier and traditional Raman identification, and can operate in contact or non-contact mode. In the non-contact mode, the operator removes the nose cone and the system guides the operator to a 10 mm standoff distance in order to further increase user safety and negate sample cross contamination. The Resolve system was commercially launched in October 2015 and can be purchased from Cobalt Light Systems, Ltd.

CURRENT PROJECTS

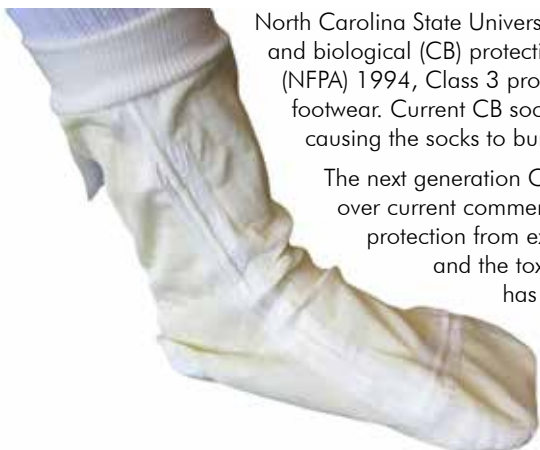
Next Generation Chemical Biological Glove

AirBoss Defense is developing a next generation chemical and biological (CB) glove that meets National Fire Protection Association (NFPA) 1994, Class 3 protection standards while providing greater tactility, durability, dexterity, and comfort over the traditional butyl glove. The current generation butyl rubber, CB gloves lack breathability and have poor heat and moisture management, which causes thermal discomfort to the user.

The new AirBoss CB glove will reduce the thermal burden and allow the user to meet their operational demands by improving dexterity while still providing extended mission percutaneous protection from exposure to the harmful effects of all traditional CB warfare agents and the toxic industrial chemicals listed in NFPA 1994. The new glove design is the first glove in the CB community that provides the high levels of protection necessary for CB response while incorporating a level of breathability.



Next Generation Chemical Biological Sock



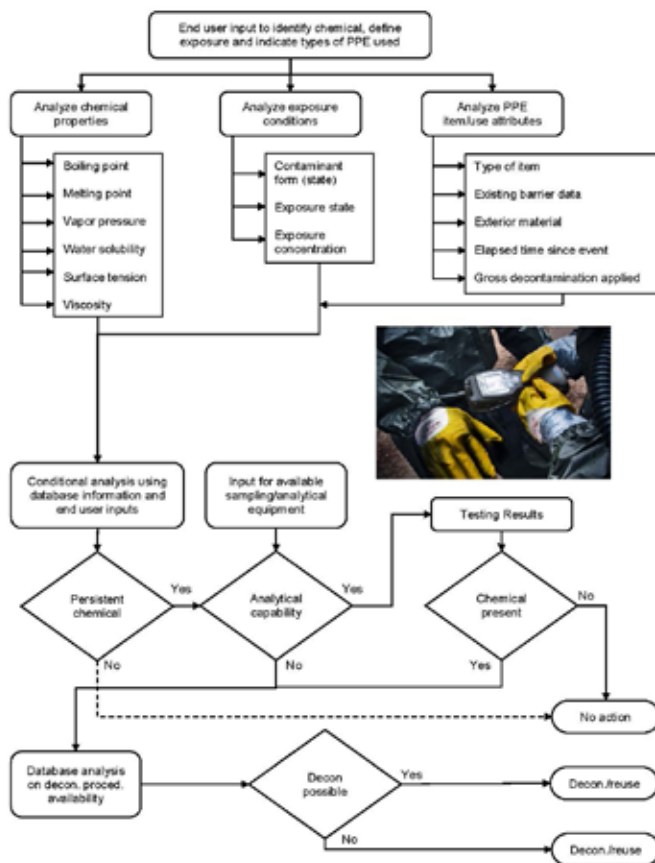
North Carolina State University and Lion Apparel, Inc. are developing a next generation chemical and biological (CB) protective sock system that meets National Fire Protection Association (NFPA) 1994, Class 3 protection standards while worn under normal combat or tactical footwear. Current CB socks are uncomfortable, not form fitting, and have excess material, causing the socks to bunch in the toe region.

The next generation CB sock can be worn unobtrusively while providing enhanced comfort over current commercial CB socks. The sock provides extended mission percutaneous protection from exposure to the harmful effects of all traditional CB warfare agents and the toxic industrial chemicals listed in NFPA 1994, Class 3. The CB sock has less material and is more form fitting allowing for integration with a variety of protective ensembles. The CB sock can be worn in temperature and humidity extremes while withstanding salt spray, seawater, rain, sand, dust, sweat, oil, and other contaminants. The CB sock is reusable when not contaminated and can be laundered for multiple cycles.

Non-Destructive Chemical Biological Analysis Techniques Enabling Effective Personal Protective Equipment Decontamination Strategies

Emergency responders are provided little guidance to determine if their personal protective equipment (PPE) is contaminated and how to decontaminate their PPE if needed. The inability to clearly evaluate contamination or consider decontamination can result in the premature disposal of expensive reusable PPE, or more importantly, result in prolonged exposure to hazardous substances.

Improved analytical techniques developed over the past few decades can be applied to key chemical, biological, and particulate contaminants to develop guidance for judging whether clothing can be decontaminated and if decontamination processes are effective. International Personnel Protection, Inc. is developing decision-based guidance to improve emergency responders' ability to judge the appropriateness for reusing PPE, apply correct cleaning/decontamination approaches, and limit continued exposure to persistent chemical, biological, or particulate hazards. Specific guidance is being developed and incorporated into the Emergency Response Decision Support System (ERDSS), a free software system provided to first responders and Government employees in the United States, Australia, and partner countries.



Ruggedized NFPA 1994 Class 3 Ensemble

Previously, the principal concerns regarding protective clothing and equipment for hazardous materials response were exposure to industrial chemicals encountered during transportation accidents or spills at fixed facilities. Now first responders, including military, law enforcement, and fire and emergency services, must be prepared for potential terrorist acts involving chemical warfare agents, highly hazardous toxic industrial chemicals, and related substances. However, end user organizations still require greater ensemble durability in harsh response environments, extended protection for longer missions, and the ability of the ensemble to accommodate a range of different types of equipment that is used in conjunction with the protective ensemble such as body armor, helmets, cooling devices, and response tools.

Blauer Manufacturing Company is developing a ruggedized ensemble that meets National Fire Protection Association (NFPA) 1994, Class 3 and NFPA 1992 protection standards. The new ensemble will be durable enough to withstand the rigorous use associated with tactical and search and rescue operations while providing a greater level of cut and puncture resistance than current Class 3 ensembles. It will also provide increased visibility, range of motion, and dexterity while not compromising existing ensemble breathability.



Small Unit Water Purifier

The most cost-effective approach for providing potable water to forward deployed troops is to purify indigenous water supplies directly at the source. Currently, potable water is provided to forward deployed troops by one of two methods. One option is to use a centralized water purification system, such as the 600 gallon per hour Reverse Osmosis Water Purification Unit (ROWPU) and 1,500 gallon per hour Tactical Water Purification System (TWPS), and then transport the potable water to the frontline. Alternatively, the deployed troops can use Individual Water Purifiers (IWPs) that are carried by

each warfighter on the battlefield, such as the TSWG/Cascade Designs, Inc.'s MSR® Inline Microfilter and ICx/MSR® GravityWorks™ Purifier. While both of these methods are effective, these solutions are problematic from a logistical perspective.

The CTTSO is working with Cascade Designs, Inc. to fill this gap with an innovative Small Unit Water Purifier (SUWP). The SUWP will offer greater flexibility than centralized systems during expeditionary operations by providing forward deployed troops their own internal water purification capability. The SUWP will also reduce the logistical burden of transporting either bulk water or IWPs in the field. The final SUWP system will achieve the required water production rate, pass the NSF P248, and meet the TBMED-577 standard for potable water.

Colorimetric Barcode

Colorimetric approaches for explosive and homemade explosive (HME) precursor detection are relatively low cost, portable, fast, and have excellent sensitivity and low training burden. While many colorimetric approaches already exist, they are serial in nature which often requires multiple steps and are prone to false positives. As part of a bilateral effort with the United Kingdom's Defence Science and Technology Laboratory, FLIR Systems, Inc., located in Boston, MA, has developed a seamlessly integrated, fully self-contained, single-use test kit for the identification of a substance through simultaneous analysis with 14 colorimetric tests each contained in a separate microfluidic channel within the cassette. The system has demonstrated class-level detection of nitroaromatics, nitrate esters and nitramines, inorganic nitrates, chlorates, and peroxide-based explosives; differentiation between inorganic chlorates and perchlorates; and differentiation of inorganic nitrates and metals (e.g., aluminum, iron, and magnesium). The operator simply swipes a surface with the sample pad located on the bottom of the cassette, closes the cap over the sample pad, bursts solvent filled blisters to dissolve the sample, and twists the cap to analyze the sample. Color changes occur approximately one minute later. Interpretation of the results can be carried out manually or automatically using a smartphone. The microfluidic platform of this system also has the capability to be expanded into detection of other illicit materials such as narcotics by switching the colorimetric reagents in each of the channel's wells.



Colorimetric Fabrics for the Detection of Explosive Materials

In the field, operators need the identification of potential explosives to be as rapid and non-labor intensive as possible. Although colorimetric detection typically provides a low-cost, portable solution with minimal operational requirements, in the past the sampling and detection process required operators to perform a series of tedious steps. Through a joint effort with the Israel Ministry of Defense, Technion – Israel Institute of Technology has developed an easy-to-use explosive swab that streamlines the analysis process by embedding the colorimetric chemistries into the fibers of a contact sampling swab. The swab's fibers are formed into a hollow "micro-tube" structure that allow for the reagents to be inserted into the hollow center as the fibers are spun. The deposition of these fibers onto a substrate creates a "sticky", rough, and intricate surface with high collection efficiency. When the swab collects the sample and the fibers are broken open, the microliter of reagent contained in the fibers is released and interacts with the sample to produce a colorimetric reaction. This design allows for the quick and seamless identification of an explosive threat, while maximizing user safety by ensuring the operator does not make contact with the small amount of reagent chemicals. Swabs, each detecting a specific threat, have been developed for nitroaromatics, nitrates, nitroamines, and chlorates/perchlorates.

Low Cost Raman

Raman based systems are simple to use, easy to maintain, and provide reliable identification of explosives, industrial chemicals, and hazardous materials. However, spending \$20,000 to \$50,000 on one system often does not fit the discretionary budgets of municipal law enforcement and smaller national agencies with non-specialist users. As part of a bilateral effort with the United Kingdom's Defence Science and Technology Laboratory, Snowy Range Instruments, located in Laramie, WY, has developed a pocket size Raman device capable of identifying bulk amounts of chemicals, explosives, and narcotics using lower cost components. Major costs savings were realized by using a consumer product laser, e.g., a CD player's laser, which is considerably less expensive due to volume production. Such a laser does not exhibit all of the behavioral characteristics of the specialist laser, but these challenges were overcome with careful component selection and management in order to produce an affordable unit without sacrificing performance.

The system's laser employs an orbital raster scan to average over a larger sample surface to allow for a higher average laser power, and dynamic raster scan measurements to provide improved discrimination of heterogeneous materials incorporated into the sample. The result of this work is a fully functional, reliable system that is affordable to local agency first responders at a price of approximately \$7,500.





MEMBERSHIP

Environmental Protection Agency

Federal Reserve Board

Intelligence Community

InterAgency Board

State and Local Agencies

- Arlington County (VA) Fire Department
- Fairfax City (VA) Fire Department
- Fairfax County (VA) Fire and Rescue Department
- Fairfax County (VA) Police Department
- New York City Fire Department
- New York City Office of Chief Medical Examiner
- New York City Police Department
- Northern Illinois Police Alarm System
- Seattle (WA) Fire Department
- Virginia Department of Emergency Management
- Virginia Department of Transportation

U.S. Capitol Police

U.S. Department of Agriculture

- Animal and Plant Health Inspection Service
- Food Safety and Inspection Service

U.S. Department of Commerce

- National Institute of Standards and Technology

U.S. Department of Defense

- Acquisition, Technology, and Logistics
- Defense Advanced Research Projects Agency
- Defense Intelligence Agency
- Defense Threat Reduction Agency
- Joint Chiefs of Staff
- Joint Improvised-Threat Defeat Agency
- Joint Program Executive Office for Chemical and Biological Defense

- Office of the Assistant Secretary of Defense for Nuclear, Chemical, and Biological Defense

- Pentagon Force Protection Agency

- U.S. Air Force Air Combat Command

- U.S. Army

- 20th Support Command, CBRNE

- 22nd Chemical Battalion

- Armament Research, Development, and Engineering Center

- Chemical, Biological, Radiological, and Nuclear School

- Medical Department

- National Ground Intelligence Center

- Research, Development, and Engineering Command, Edgewood Chemical Biological Center

- U.S. Marine Corps

- Chemical Biological Incident Response Force

- Explosive Ordnance Disposal

- Systems Command

- U.S. Navy

- Bureau of Medicine

- Naval Air Warfare Center

- Naval Explosive Ordnance Disposal Technology Division

- Naval Forces Central Command

- Naval Research Laboratory

- Naval Surface Warfare Center

- U.S. Special Operations Command

U.S. Department of Energy

- National Nuclear Security Administration

U.S. Department of Health and Human Services

- Centers for Disease Control and Prevention

- Food and Drug Administration

- National Institute for Occupational Safety and Health

U.S. Department of Homeland Security

- Federal Emergency Management Agency

- Federal Protective Service

- Office of Health Affairs

- Science and Technology Directorate

- Transportation Security Administration

- Transportation Security Laboratory

- U.S. Coast Guard

- U.S. Secret Service

U.S. Department of the Interior

- National Park Service, United States Park Police

U.S. Department of Justice

- Bureau of Alcohol, Tobacco, Firearms and Explosives

- Federal Bureau of Investigation

- National Institute of Justice

- U.S. Marshals Service

U.S. Department of Labor

U.S. Department of State

- Bureau of Arms Control, Verification and Compliance

- Bureau of Counterterrorism

- Bureau of Diplomatic Security

- Bureau of Overseas Buildings Operations

U.S. Department of Transportation

- Research and Innovative Technology Administration (Volpe Center)

U.S. Senate Sergeant at Arms

White House

- Homeland Security Council

- Office of Science and Technology Policy



IMPROVISED DEVICE DEFEAT/ EXPLOSIVES COUNTERMEASURES

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FOCUS AREAS

Improvised Device Defeat

Improve or develop operational capabilities to neutralize, render-safe, and contain blast and fragmentation during improvised terrorist device, and explosives response operations.

Device Diagnostics and Threat Characterization

Provide advanced technologies and technical solutions that improve identification, analysis, and technical characterization of explosives, improvised explosive devices (IEDs) and their components, and potential weapons of mass destruction in support of response operations.

Robotics and Remote Means

Develop or enhance platforms, systems, and technologies to remotely conduct activities related to the neutralization or rendering safe of IEDs, unexploded ordnance (UXO), homemade/improvised explosives and their precursors, and enhanced hazard devices containing chemical, biological, or radiological materials.



COMPLETED PROJECT

Underwater Explosive Threat Tool Kit



The Underwater Explosive Threat Tool Kit effort developed a suite of tools used to perform render safe procedures (RSP) against underwater limpets, other mines, and improvised explosive devices (IEDs). Intended for use by U.S. Navy Explosive Ordnance Disposal (EOD) and Mine Countermeasures (MCM) Forces, the suite of tools took pre-existing charge containers, one shaped charge and one explosively formed penetrator, and replaced the copper liner of these tools with a liner containing an energetic material. The tool containers are designed to be hand-packed with plastic explosives just prior to use. The tool achieves a low-order explosion and/or burn effect, or a general disruption effect against live targets underwater without causing a high-order detonation to minimize collateral damage to the hull. The tools are being considered for inclusion in a Navy EOD Program of Record.

CURRENT PROJECTS

Force Feedback Retrofit Kit

The Force Feedback Retrofit Kit (FFRK) seeks to address the problem of a lack of force feedback on the grippers of existing and future mobile manipulator robotic platforms. Robots have become an integral part of bomb squads, military EOD technicians, and other emergency response teams, and have enabled squads to remotely investigate and transport suspicious items before sending humans into potentially dangerous situations. Because of the instability and uncertainty of the potentially explosive items being investigated, it is critical to securely grasp components without using excessive force that could crush components or set off explosive charges. Without force feedback from the gripper to indicate the strength of the grip, the user has no information on how forcefully the objects are being grasped. The FFRK will provide robotic operators with this critical information on how securely objects are being grasped.



The FFRK will provide robotic operators with this critical information on how securely objects are being grasped and will do so in a way that is low cost and easy to install on the existing robot fleet.



Water-Borne Improvised Explosive Device Remotely Operated Vehicle

While the past decade has seen substantial development of ground-based robotic capabilities to counter improvised explosive device (IED) threats remotely, explosive threats in maritime environments often require military EOD and Public Safety Bomb Technicians (PSBTs) to perform render safe operations manually. The Water-Borne Improvised Explosive Device (WBIED) Remotely Operated Vehicle (ROV) is a two-man portable, tethered, unmanned underwater vehicle designed to search for, identify, and neutralize WBIEDs. It also features a five-function electric manipulator arm, can operate

in 2.5 knot currents, and includes way point navigation and station keeping capabilities. The WBIED ROV will minimize the need for EOD divers to enter the water and thus minimize their exposure to explosive threats.

Western National Robot Rodeo and Capability Exercise

The evolving threat from IEDs requires EOD and Public Safety Bomb Squad (PSBS) personnel to maintain and enhance their skills in challenging, real world operating environments. The Western National Robot Rodeo and Capability Exercise (WNRR CAPEX) offers EOD and PSBS personnel a wide variety of IED threat scenarios that test critical thinking and robotic operation skills in a timed and judged competition. In addition, the scenarios allow operators the opportunity to use newly developed C-IED technologies and offer on-site feedback to vendors present at the event. The 9th WNRR CAPEX featured ten scenarios over the course of four days at Kirtland Air Force Base and Sandia National Laboratories in New Mexico. Ten teams took part in the competition, several of whom had competed at previous WNRR CAPEX events. In addition to maintaining and enhancing skills for EOD and PSBS personnel, the WNRR CAPEX also serves as a vital opportunity to collect and refine operational and technical requirements needed to develop next generation IED defeat capabilities.



Next Generation EOD X-ray Generator



The Next Generation EOD X-ray Generator will provide an enhanced capability to identify objects and electronic circuitry through heavy metallic shielding. The system will be designed to allow easy integration of X-ray capabilities with remotely operated and digital scanning systems. The system will be modular, incorporating easy transmission of improvised explosive device (IED) and weapons of mass destruction (WMD) information, advances in 3D X-ray imaging, and overlay of targeting information to better inform the decision making process for selecting render safe procedures. Technology advances allow the system to operate indefinitely and provide an over forty percent increase in image resolution while being housed in a form factor that is smaller and lighter than current systems.

Rapid Bomb Neutralization: Roly Poly

The ability to disrupt an improvised explosive device (IED), whether a package sitting in the open, or a device found in a vehicle, are limited. At present, only two options are viable: 1) a manual approach, where a bomb technician approaches the device in a bomb suit and manually aims the disruptor, which greatly extends the bomb technicians time-on-target, or 2) with a disruptor attached to a robot, which may not always be able to gain access to the IED circuitry because of the robots size and weight, or aim the disruptor well because of the robot arms limited dexterity. This effort develops a low-cost tool that can be delivered either manually or robotically very quickly, allowing the bomb technician or robot to withdraw from the scene quickly, precisely aim an attached disruptor or shaped charge from a safe location, and quickly and efficiently disrupt the device with minimal risk to the bomb technician or robot. This effort, being developed under a bilateral agreement with the Israel Ministry of Defense, is a follow-on effort stemming from a project called Humpty Dumpty, through which a





dynamic, multi-sectioned, shaped charge was developed for use by Special Operations Forces. When used with a disruptor rather than a shaped charge, Roly Poly becomes a lightweight, inexpensive, reusable disruptor system that can be remotely aimed and positioned to perform reconnaissance or render safe operations. The system includes a miniature tripod stand attachment for use in uneven terrain. The system will be commercially available as the Raptor from Concept Development Corporation of Fountain Hills, AZ.

MEMBERSHIP

Intelligence Community

National Bomb Squad Commanders Advisory Board

State and Local Law Enforcement

- Arizona Department of Public Safety (Western Region)
- Delaware State Police (Eastern Region)
- Fairfax County (VA) Police Department
- Houston (TX) Police Department (Central Region)
- Maryland State Police
- Michigan State Police
- Pittsburgh (PA) Bureau of Police
- South Carolina Law Enforcement Division (Southern Region)

U.S. Capitol Police

U.S. Department of Defense

- Pentagon Force Protection Agency Bomb Squad

- U.S. Air Force
 - Air Combat Command
 - Explosive Ordnance Disposal Technical Detachment (AFCEC/CXE)
- U.S. Army
 - 52nd Ordnance Group
 - Explosive Ordnance Disposal Technical Detachment
- U.S. Marine Corps
 - Chemical Biological Incident Response Force
 - Explosive Ordnance Disposal Detachment
- U.S. Navy
 - Explosive Ordnance Disposal Fleet Liaison Office
 - Explosive Ordnance Disposal Technology Division
 - Training and Evaluation Unit-2
 - Training and Evaluation Unit-5

U.S. Department of Homeland Security

- Homeland Security Advanced Research Project Agency
- Office for Bombing Prevention
- Science and Technology Directorate
- Transportation Security Administration
- U.S. Coast Guard
- U.S. Secret Service

U.S. Department of Justice

- Bureau of Alcohol, Tobacco, Firearms and Explosives
- Federal Bureau of Investigation
- National Institute of Justice



INVESTIGATIVE AND FORENSIC SCIENCE

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FOCUS AREAS

Credibility Assessment (Detection of Deception and Intent)

Develop improved interviewing and interrogation equipment, methods and techniques through behavioral/operational psychology advancements, including psycholinguistics, cognitive methods, and motivational techniques.

Criminalistics

Improve the recognition, documentation, triage, collection, analysis and preservation of evidence and actionable information for future prosecution or targeting. Create advanced capabilities in the traditional forensic science disciplines to identify individuals and improve the recovery, identification, evaluation, and analysis of material and traces. Develop benchtop and handheld instrumentation that decreases throughput time and automates (lights out) interpretation.



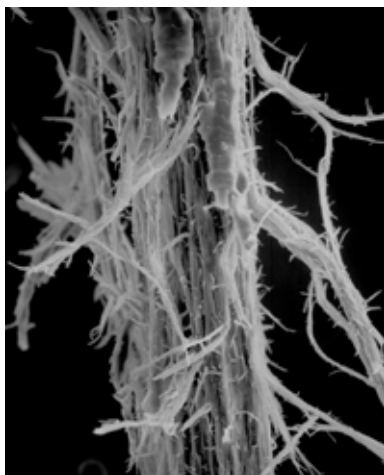
Digital and Multimedia Forensics

Develop computer forensic hardware, software, decryption tools, and digital methods to investigate terrorism. Develop advanced methods to extract, decrypt, analyze, and enhance audio recordings, video images, and other forensic information from analog and digital sources.

Forensic Exploitation

Develop a lexicon, common operating procedures, and advanced techniques for material and personnel exploitation of sensitive sites, caches, targeted objectives, and incident scenes. Advance the portable and packable expeditionary and “reach back” exploitation analysis capabilities for level I, II, and III forensic analysis. Improve law enforcement-related technical surveillance methods.

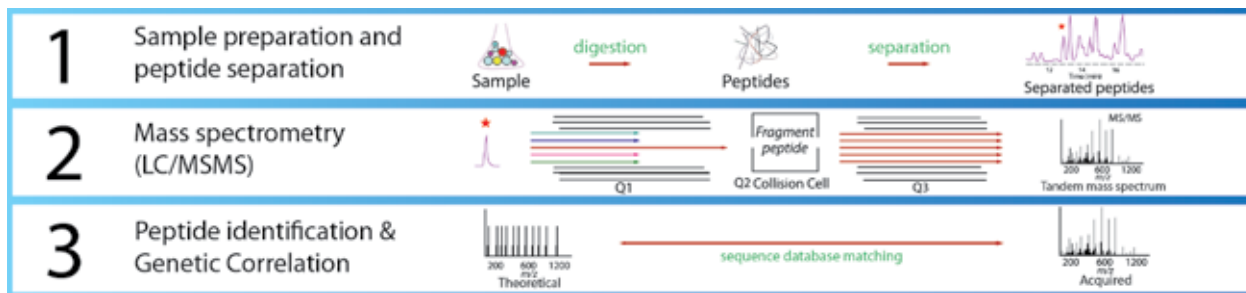
COMPLETED PROJECTS



Human Identification through Protein Polymorphisms (PPIMS)

Methods are required to identify individuals in an unbiased way using non-DNA biological means. DNA-based methodology presents significant challenges when there are multiple contributors, as mixtures are particularly difficult to deconvolute. Additionally, DNA itself is highly unstable under certain environmental conditions, resulting in poor data yields. Alternatively, the use of polymorphic peptide biomarkers as a means to identify individuals presents advantages due to the increased stability and persistence of the target proteins in the environment. While demonstrated to be a viable approach to human identification, there remains a significant amount of methodology development for sample processing, data analysis and validation. Lawrence Livermore National Laboratory (LLNL) has begun this process by developing a forensic technique that exploits proteins as DNA surrogates to identify individuals using trace biological evidence. Since proteins are coded by DNA, mutations in the DNA of an individual can appear as changes in proteins. Specifically, by analyzing protein amino acid sequences, they have located amino acid

substitutions that allow peptides to serve as markers that can, in turn, be used to build identification profiles for individuals. Identification profiles of this nature with high powers of discrimination required the discovery of a large number of additional peptide markers, which LLNL greatly succeeded at. The large number of markers isolated will not only increase the power of discrimination with this technique, but will reveal information beyond simple identification. Some markers discovered in this project will inevitably be linked to biogeographic origin or familial relationships.



Best Practices for Expeditionary Forensics



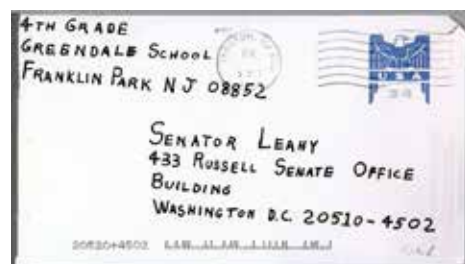
Since the start of the military missions in Iraq and Afghanistan, the U.S. military and its coalition partners have conducted extensive expeditionary forensic operations. These operations have spanned the entire range of forensic technologies and have involved on-site support as well as reach back capabilities. With no central agency overseeing all of the forensic

expeditionary operations, no one person or organization knows what has been done or attempted. Likewise, outside individual agencies no one knows what procedures were successful or ineffective. The forensic capabilities which were actually needed by the military forces and those which were superfluous are unknown. The Center for Naval Analyses researched and documented the best practices for expeditionary forensics, with emphasis placed on U.S. forces and its coalition partners, in a comprehensive report. All branches of the military and intelligence community were examined to determine the practices and procedures that were most effective down range and those least effective. Besides the best practices, methods and procedures were determined to avoid negative experiences in future forensic expeditionary operations, as well as provide lessons learned that could be lost during the retrograde of expedition forensic operations from Iraq and Afghanistan.

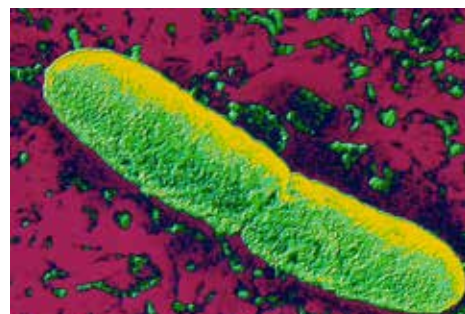
Forensic Microbial Proteomic Assessment and Development (LIGHTNING BUG)

Proteomics is the large-scale study of proteins, particularly their structures and functions. There is a critical need for methodologies beyond genomics to identify and characterize bio threat agents (BTAs) to assist in source attribution. The BTA proteome is an excellent target for analysis as it can be highly sensitive to culture conditions, post-culture treatments, and environmental effects after BTA dissemination.

A key challenge to applying proteomics is creation of proteomic signatures with high resolution and reproducibility, and at low cost with minimal or no investment in novel technology. Understanding the proteome, the structure and function of each protein, and the complexities of protein-protein interactions, will be crucial for developing the most effective forensic diagnostic techniques. Pacific Northwest National Laboratory (PNNL) answered key questions in microbial forensics to which proteomic analysis can contribute significant information. The first objective was for PNNL to review scientific literature and conducted *in silico* analysis of existing protein databases to determine potential targets for forensic proteomics, focusing on *Yersinia pestis*, *Bacillus anthracis*, and *Clostridium botulinum*. They also reviewed existing data that supports the literature and *in silico* predictions, while collecting additional data to determine the stability of proteomic signatures through serial passaging. The second objective was to evaluate the commercially available proteomic analysis platforms such as liquid chromatography-mass spectrometry instruments to identify those most suitable for forensics applications. This included evaluation of data analysis algorithms and determination of the best approaches for data extraction, analysis and interpretation. The third objective was to identify the key gaps in the experimental data that need to be filled with additional research, plus the establishment of a roadmap to fill these gaps. Included in this is a proposed validation plan for the current best identified methods/applications of proteomic analysis for microbial forensics.



Courtesy of the Federal Bureau of Investigation





Mobile Device Analysis Corpus

Terrorists and criminals have fully integrated the use of electronic mobile devices into their criminal activities and daily lives. The evidence and intelligence obtained from these devices can be tremendous. Agencies involved in law enforcement and combating terrorism activities collect a large number of mobile devices every day. Their biggest challenge is to categorize and process these items of evidence efficiently to get the most value from them with limited manpower. There are a myriad of tools and techniques available to acquire the information in mobile devices based on the circumstances and device presented for analysis. The challenge is made more complex because of the thousands of new mobile devices made commercially available annually. VECTARE, Inc. is developing a hardware/software system that catalogs all samples/units in a mobile device analysis corpus into a networked electronic file system. The hardware of the system will have a central processing unit, a printer with a 2D barcode sticker capability, a sheet feed scanning device, a monitor, a keyboard, a 2D barcode scanning reader, and a digital single-lens reflex camera. The software of the system will document and record multiple data elements from each sample in the corpus. Some of these elements include; a unique identifying number for each sample; case administrative information such as incoming tracking information, seizure number, and intake type; sample/unit related information such as manufacturer, carrier, device type, serial number, model type and number; and automated quantization of successfully extracted logical data elements such as call log entries, incoming calls, and NMS messages.



Remote Imaging Card Unit

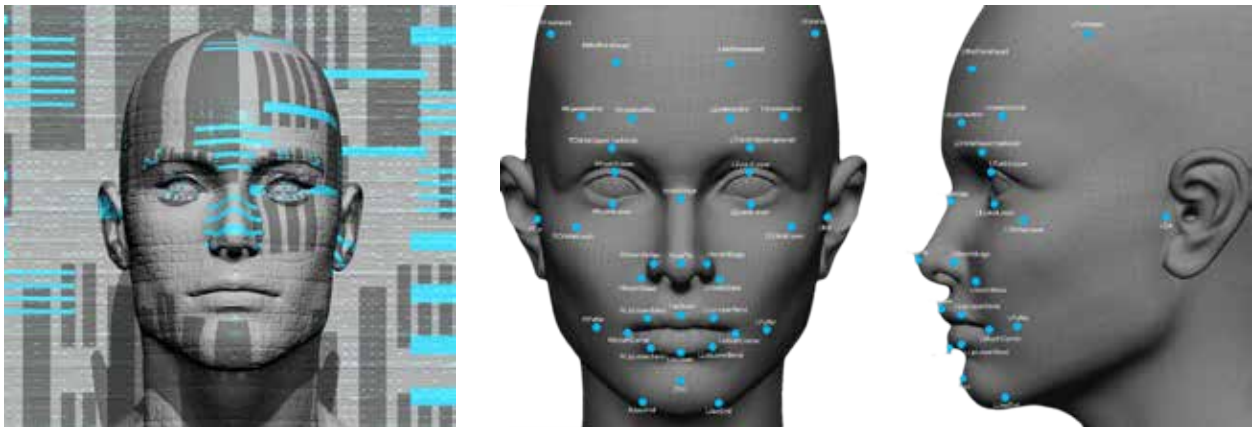
At many screening points, such as airports or ports of entry, persons are required to present an identification card. A screener will encounter many different types of ID cards, but it is impossible for the screener to be familiar with all of them. The screener's experience and training will provide a sense of which identification cards are counterfeit. However, at times the screener will not have a sufficient basis to confirm its status. A trained forensic document

examiner would have the additional experience to make that determination. The issue becomes that these examiners are not located at screening points and are relatively scarce. ID Scientific is developing a hardware and software system that point-of-inspection screeners can use to electronically submit suspected CR-80 sized identification documents to a forensic laboratory. The hardware will allow for fast and easy acceptance of the document and capture all document information on the front and back, including optical images in an automated manner. The system will read the information, including coded data on any magnetic stripes, and collect images of security features. Any optical variable devices will also be captured at various angles of illumination. The system will electronically transmit the captured data within two minutes to a forensic laboratory. An alert will be made to a forensic examiner who after making an examination can transmit the results back to the field operator. The size of the hardware unit will be less than 30 by 30 by 45 centimeters and weigh less than 12 kilograms.



Facial Recognition/Identification from Uncontrolled Images and Video

Law enforcement and combating terrorism forces often acquire videos, images, and photos which yield valuable evidence and intelligence about the persons in them. Identifying or recognizing the persons in these graphics is the key to gaining this actionable intelligence. Presently, no technology exists that can comprehensively analyze all types of uncontrolled video files or formats to identify or recognize the persons within them. Specifically, identifying a person in a video or image often provides positive proof that the individual was involved in a crime or terrorist activity. The present technology only works with certain types of files or has other limitations restricting its ability to provide operators with the required analysis. The facial recognition-identification from uncontrolled images and video system will provide the needed capability and allow law enforcement and U.S. forces to obtain critically needed evidence and intelligence from videos, images, and photos. Progeny Systems Corporation is developing a software application that automatically scans large volumes of digital photos, images, and videos to detect faces and heads from a range of angles. The application will provide clustering and grouping of similar appearing faces, as well as facial recognition of image and video data. The system will allow operators to manually edit and correct the groupings and clustering if desired. The software will cross-match these clusters with other clustered datasets and serve as the gallery against which 1-to-N type searches may be conducted. The application will analyze images and videos whose format is not controlled by the acquiring agency. The analysis will incorporate methods and technology combining general and specific facial characteristics, unusual details such as scars and tattoos, and features about the surroundings in the images and videos to identify criminals and victims. The analysis algorithms will also include computer learning techniques, biometric facial recognition enhancements, and other improved and advanced recognition technology.





MEMBERSHIP

Environmental Protection Agency

- National Enforcement Investigations Center

Federal Reserve Board

Intelligence Community

National Forensic Science Technology Center

National Transportation Safety Board

U.S. Department of Commerce

- National Institute of Standards and Technology, Office of Law Enforcement Standards

U.S. Department of Defense

- Component Commands
- Defense Advanced Research Projects Agency
- Defense Computer Forensics Laboratory
- Defense Cyber Crime Institute
- Defense Forensic Enterprise, Office of the Under Secretary of Defense for Acquisition, Technology, and Logistics
- Defense Forensic Science Center
- Defense Forensics and Biometrics Agency
- Defense Intelligence Agency
- Defense Threat Reduction Agency

- Headquarters, U.S. Marine Corps
- Intelligence Systems Support Office, Office of the Under Secretary of Defense for Intelligence
- Joint Improvised-Threat Defeat Agency
- National Center for Credibility Assessment
- National Geospatial Intelligence Agency
- National Media Exploitation Center
- Naval Research Laboratory
- Office of the Provost Marshal General
- Pentagon Force Protection Agency
- U.S. Air Force Office of Special Investigations
- U.S. Army Criminal Investigation Command
- U.S. Navy Naval Criminal Investigative Service
- U.S. Special Operations Command

U.S. Department of Energy

- Office of Environment, Health, Safety, and Security
- Office of Inspector General

U.S. Department of Health and Human Services

U.S. Department of Homeland Security

- Customs and Border Protection
- Federal Emergency Management Agency
- Federal Protective Service
- Homeland Security Investigations Forensic Laboratory
- Immigration and Customs Enforcement
- Transportation Security Administration
- Transportation Security Laboratory
- U.S. Secret Service

U.S. Department of Justice

- Bureau of Alcohol, Tobacco, Firearms and Explosives
- Drug Enforcement Administration
- Federal Bureau of Investigation
- National Institute of Justice
- U.S. Marshals Service

U.S. Department of State

- Bureau of Counterterrorism

U.S. Department of Transportation

- Federal Aviation Administration

U.S. Department of Veterans Affairs

U.S. Postal Inspection Service



IRREGULAR WARFARE AND EVOLVING THREATS

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FOCUS AREAS

Advanced Influence and Information Capabilities

Conduct research, operational analysis, capability design, and implementation support to develop new tools, techniques and activities that enable our forces to influence, disrupt, corrupt, or usurp the decision making of adversaries and potential adversaries within the physical, information, or cognitive domains of the information environment.

Counter-Network Concepts and Capabilities

Conduct research, analysis and development of new concepts and capabilities that integrate unique skill sets of combined, multi-agency and multi-national domains to identify and interdict threat networks and enterprises.

Partnership Capacity Development

Conduct research, operational analysis, capability design, and implementation support in order to more effectively assist, train, advise, and influence foreign partners, foreign competitors, adversary leaders, and relevant populations in support of expeditionary, low-cost, small-footprint operations in the air, land, maritime, and cyber domains.



COMPLETED PROJECT



Android Tactical Survey Kit

Assault zone surveys are required to ensure airlift platforms are able to insert and recover assault forces and equipment as well as to support the full range of military operations. Teams conducting this specialized mission are at risk when performing this action due to the amount of time and effort required to gather and compile accurate data. The Android Tactical Survey Kit (ATSK) was developed in response to a requirement for a low signature solution that could be used easily and with low visibility to allow collection of data to determine landing and drop zone feasibility in support of these missions.

This effort leverages modern commercial capabilities in processing, display, communications, and smartphone technologies in order to provide a straightforward user interface that enforces a simplistic workflow process and ease of use. This interactive solution accessible on a mobile Android device gives qualified end users a cost effective, standardized, and easily accessible way to collect, assess, and generate assault zone surveys. ATSK reduces the amount of gear and equipment required for the survey process and breaks out the survey process into smaller subtasks, thus allowing the user to focus on a specific task while maintaining awareness of the overarching survey as a whole.

CURRENT PROJECTS



Virtual Currency Transaction Analysis

Virtual currency transactions (Bitcoin) have been used for illegal activities where the parties wish to remain anonymous. Transactions often include illegal drug and arms trafficking. As Bitcoin is controlled, predictable and is open source, the processes and Blockchain data may be exploitable. This effort explores the rapidly evolving architecture of threat finance networks within a radically connected hybrid warfare context. It uses statistical models of virtual currency transactions to detect illicit

activity and will develop a web-based tool to analyze Bitcoin transactional data.

During the first phase, research was conducted to determine if actionable information could be derived by analyzing Blockchain data. A preliminary model was developed that used publicly available information to analyze historical Bitcoin Blockchain data to derive user level metrics and tags to determine whether user transactions are suspicious. The project is currently developing a functional model using near real-time downloads of Blockchain data to determine a probability that users appear to be conducting narco-trafficking related behaviors (e.g., it is a marketplace, vendor, or similar associate). Using an agile approach to model development and incorporating regular interaction and feedback, a test query template will be used for scoring suspects.

Holistic Capacity Building Framework

Interagency and international capacity building operations are frequently hampered by a lack of standards and common processes that effectively leverage the unique strengths and authorities of contributing member states. This project aims to map existing capacity building capabilities and authorities for the U.S. interagency and its allies, identify significant gaps, issues and successes and propose the implementation of a better framework for use across a host of complex supported nation challenges.

The project will develop curriculum and an accompanying guidebook to frame how to design and deliver a well-coordinated holistic approach to capacity building. It will assist strategic, operational and tactical planners/practitioners by encapsulating all aspects of capacity building, provide detailed guidance on accessing required authorities, approvals and funding and provide advice for working with governments, agencies, organizations and communities as necessary. This effort will help meet the complex security and related supported nation challenges effectively and sustainably in order to have maximum impact on manpower and investment.

The applied research and associated products will provide methodologies for how to better apply a Whole-of-Government(s) approach to security force assistance and capacity building operations.



Conflict Zone Tool Kit

The Conflict Zone Tool Kit (CZTK) is a web-based, situational awareness and analytic platform that resides on an accredited secure unclassified network (accessible from a commercial Internet browser) that empowers analysts and operators with leading edge tools to enable near real-time situational awareness from host-nation perspective ('green lens') related to activities and actors of concern. CZTK allows users to apply the best data and applications needed to characterize and geospatially visualize the information environment for operational level planning and a range of tactical missions.



The CZTK accredited plug-and-play web-based platform provides a collaborative knowledge environment in an enclave for information sharing that characterizes and geospatially visualizes human and physical terrain through open source social media and other publicly available information in support of operational level planning and a range of tactical missions. A key aspect of the system is that U.S. and trusted partner users access data and analytic tools via a standard Internet browser. The CZTK technology operating within the SUNet platform has been accredited by the U.S. Government under the Department of Defense Information Assurance Certification and Accreditation Process with a Global Information Grid (GIG) Waiver from the Department of Defense Chief Information Officer.

Secure Unclassified Network

The Secure Unclassified Network (SUNet) is an accredited web-based platform offering a universal, secure and global collaboration capability for multi-agency users (Law Enforcement, Interagency, Coalition, and Foreign Nationals). This agile platform has the ability to segment users, data, and tools, creating an otherwise unavailable capability for traditional and non-traditional mission partners to share data, collaboration spaces, secure email, and advanced analytic tools in support of mission requirements.

SUNet is Department of Defense Information Assurance Certification and Accreditation Process (DIACAP) compliant and is accredited up to For Official Use Only and Law Enforcement Sensitive. Additionally, it has a Department



of Defense Authority to Operate as well as a Global Information Grid (GIG) Waiver from the Department of Defense Chief Information Officer on the grounds that it provides a unique capability that is not currently available in the Defense Information System Network. SUNet has been deployed in a variety of operational settings in support of a number of users (including host nation partners), and has been selected by Defense Threat Reduction Agency as the off-GIG portion of their Constellation enterprise. Within 48 hours, SUNet was rapidly deployed in support of emerging Ebola Regional Contingency Team requirements, creating a shared environment within which partner organizations were capable of exchanging information and coordinating operations in the region.

MEMBERSHIP

Intelligence Community

United Kingdom

- Defence Science and Technology Laboratory
- Strategic Analysis Group – Policy and Capability Studies

U.S. Agency for International Development

U.S. Department of Defense

- Coalition Joint Forces Land Component Command
- Defense Advanced Research Projects Administration
- Defense Institute of Security Assistance Management
- Defense Security Cooperation Agency
- Defense Threat Reduction Agency

- Joint Center for International Security Force Assistance
- Joint Staff (J-5/J-7)
- National Defense University, Center for Complex Operations
- Peacekeeping and Stability Operations Institute
- Office of the Secretary of Defense
- U.S. Africa Command
- U.S. Army War College
- U.S. Central Command
- U.S. Forces-Afghanistan, CJ-2, Train Assist and Advise
- U.S. Marine Corps
- U.S. Navy
- U.S. Pacific Command
- U.S. Special Operations Command

U.S. Department of Homeland Security

- Immigration and Customs Enforcement

U.S. Department of Justice

- Drug Enforcement Administration

U.S. Department of State

- Bureau of African Affairs, Office of Regional Security Affairs
- Bureau of Educational and Cultural Affairs
- Bureau of International Narcotics and Law Enforcement
- Bureau of Near Eastern Affairs, Office of Assistance Coordination
- Center for Strategic Counterterrorism Communications

U.S. Department of the Treasury

- Office of Terrorism and Financial Intelligence



PERSONNEL PROTECTION

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FOCUS AREAS

Communications and Situational Awareness

Develop situational awareness and communication capabilities that aid in identifying threat indicators, conducting risk assessments and providing early warning to personnel providing protective services for VIPs. Develop tools to facilitate situational awareness, reporting, and communications for incident response personnel.

Individual Protection and Survivability

Develop advanced personnel protection systems that mitigate ballistic, blast, and emerging operational threats. Personal protective equipment focuses on novel materials and designs to provide maximum protection.

Personnel Tracking and Recovery

Develop inconspicuous systems to geolocate and track high risk personnel, signal situations of duress, and facilitate recovery of missing or captured personnel.



Ballistic and Blast Threat Assessment

Research ballistic and blast effects on the human body and develop guidelines, tools, and techniques to mitigate the effects.

COMPLETED PROJECTS



Graphics Processing Unit Map

Graphics Processing Unit (GPU) Map is a software package developed by Raytheon Blackbird Technologies, which provides accurate data for street map and asset tracking in environments where network bandwidth and local storage are restricted. With GPU Map, data is stored in a compact format to decrease the storage footprint. GPU Map includes three cooperating software solutions working together to enable operators to locate and track personnel and vehicle assets. The first is an automated system for regularly downloading and updating Open Street Map (OSM) data, organized by continent and country. The second solution is a map-rendering library that provides custom styling options to render map data both on-the-fly and with cached tile sets. The map-rendering library reads data directly from Spatialite-formatted spatial database files and is employed on the end user system. The third solution is a desktop application that allows for the loading and visualization of maps created by the rendering library, while providing tracking data overlay capability from third-party sources streamed via a secure channel. GPU Map is being deployed for use in field operations.

InstantEye Enhanced Payload Development

Physical Sciences, Inc. previously developed the InstantEye small unmanned aircraft system (sUAS) as a discrete, overhead intelligence, surveillance, and reconnaissance platform intended for special operation forces. InstantEye has been successful during operational deployments by United States Special Forces and numerous federal, state, and local agencies. The proliferation of the InstantEye system has led to many end user requests for additional payloads tailored to their mission. This effort developed additional payloads for the original aircraft in response to end user needs. The first payload is a 720p high definition, digitally stabilized video camera on a one-axis gimbal to enable high resolution video recording to the ground control station. The second payload is a high zoom, digitally stabilized camera with a co-aligned laser indicator to enable day/night target identification and handoff



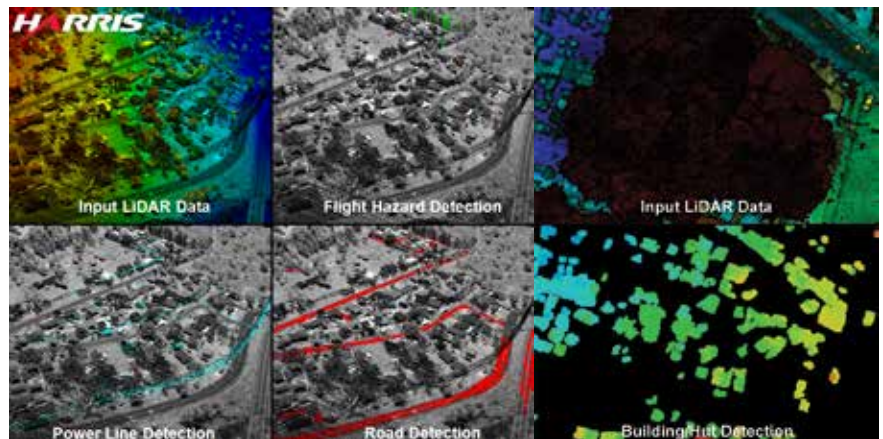
to higher power target designators. The third payload is a strobe/hailer that may act as a flash bang device to stun and disorient personnel or act as a flying beacon to alert, guide, and direct personnel below. The strobe/hailer contains an array of high output light-emitting diodes and high output speakers to deliver prerecorded audio.

Automated Light Detection and Ranging (LiDAR) Feature Extraction

Light Detection and Ranging (LiDAR) sensors are flying on diverse aircraft in multiple theaters. As a result, datasets are increasing in number, size, coverage area, and resolution. Demand for LiDAR products with rapid exploitation and near real-time products is increasing while the time available for processing exploitation and dissemination (PED) teams to exploit the data is decreasing. Fully or partially automated LiDAR data exploitation tools are required to remedy the current bottleneck in operational LiDAR exploitation cells. Raytheon Company and Harris Corporation developed algorithms to detect man-made objects concealed by foliage and in open environments. The Raytheon algorithm focuses on detecting buildings and huts, while the Harris algorithms focus on detecting roads, power lines, and vertical obstructions. Together, these capabilities aid analysts in quickly locating hidden training camps and manufacturing locations used by terrorists and illegal drug traffickers, particularly in Southern Command (SOUTHCOM), Africa Command (AFRICOM), and Pacific Command (PACOM). Detection of power lines and vertical obstructions also enables analysts to identify flight hazards for air support.

The algorithms have been tested on several LiDAR sensors including Tactical Operational LiDAR (TACOP), Airborne Laser Detection and Ranging (LADAR) Imaging Research Testbed (ALIRT), Jungle Advanced Under Dense-Vegetation Imaging Technology (JAUDIT), and MACHETE. The software tools are provided as free plug-ins to Applied

Imagery's Quick Terrain Modeler, a 3D point cloud and terrain visualization software package used by military and intelligence analysts. Command-line Linux versions have been provided to the MACHETE ground processing station and Windows versions for use with the Geospatial Repository and Data Management System (GRID), the National Geospatial-Intelligence Agency's national 3D point cloud archive.



Mobile Blast Mitigation Barrier

High risk personnel (HRP) and their families often visit areas that have protection vulnerabilities and a higher risk for acts of violence that threaten their safety. In an effort to provide greater protection for HRP, a mobile blast barrier was developed using a unique Kevlar layup to mitigate fragmentation resulting from an improvised explosive device placed on the other side of an exterior wall or in an adjacent room. The blast barrier system is easily transported and deployed temporarily where HRP are staying overnight to provide protection against fragmentation in the event of an incident.

The Mobile Blast Mitigation Barrier was developed and is manufactured by Plasan Sasa, Ltd. in Israel.





CURRENT PROJECTS

Ballistic Clay Characterization

When testing body armor, test laboratories affix the body armor on to blocks of Roma Plastilina modeling clay. During the ballistic impact, the clay block provides support to the armor and also captures the backface deformation by plastically deforming, providing a witness shape of the deformation caused by the projectile. The standard clay block used for testing is 24 by 24 by 5 inches and is constrained on 5 sides by a wood or metal box, leaving a 24-by-24 inch flat surface as the strike face. When testing female body armor, the clay is built up above the normal flat surface of the clay block. The built-up clay is not constrained around the perimeter like the standard clay block and may behave differently, resulting in different ballistic test results. Body armor should fit snugly and lay flat against the body, but proper fit can be difficult to achieve against curvatures of the human body, especially those of female wearers. Users often experience gaps between the body armor and the body due to bust separation and



buckling of the armor. It is very likely that armor performance tests on a standard flat clay block, on built up regions, and gaps simulating real world conditions will all have different results. In this effort, HP White Laboratories, Inc. will quantify the performance difference caused by gaps and built up regions. The results of the study will inform developers of body armor standards, allowing them to consider this variability in establishing test protocols.



Ballistic Face Shield

Tactical operators participate in raids requiring forced entry into facilities. The first person through the door is, at least momentarily, the lone target of enemy resistance until joined by the rest of the team. Breachers' center masses are well protected by body armor, but there has been little development in ballistic protection for the head, neck, and face. The Naval Research Laboratory (NRL) is working on two approaches to develop one element of a head and face protection system. One approach will integrate contemporary ceramic ballistic materials into an opaque face shield for the enhanced combat helmet. This face shield is opaque and eliminates vision, so the effort will also develop a zero latency vision system which will project the operator's normal field of vision to the inside of the face shield, preserving and possibly enhancing situational awareness. The second approach develops a novel recipe of transparent armor into an enhanced combat helmet. NRL has recently been awarded a patent for this innovative combination of materials. This effort will provide a vital step forward in head protection for tactical operators.



Multiple Radio Device

Dismounted field operators are required to perform coordination, collaboration, and situational awareness tasks from any location around the world. Operators must maintain multiple lines of sight (LOS) and beyond lines of sight (BLOS) communication channels to ensure successful mission execution and synchronization with a variety of fielded systems used by command and control (C2), support platforms, and team members. To maintain connections the operators must travel with and maintain custody of at least eight pieces of communications equipment simultaneously, including five separate legacy radio based communications devices for each operator. Physical Optics Corporation is developing the Multiple Radio Device which will combine the functionality of the AN/PRC-152A/117G, Motorola XTS-5000, Secure Iridium satellite phone (that supports IP data transfer from user applications and voice), and GSM/4G-LTE mobile phone into a single communications device. The Multi Radio device is designed to be no larger than 3.5 by 11 by 3.5 inches and weigh no more than 5 pounds. The device is being designed with communications security (COMSEC) key load functionality to enable secure communications during missions.



Wireless Tactical Communications Headset

The U.S. Army Special Forces (SF) is presented with unique challenges that require a balance between operational effectiveness and personnel safety. Communication is a key factor in operational effectiveness, and SF operators must monitor the operational environment for acoustic cues and communicate with their team. Many operators sacrifice their hearing protection in order to better monitor communications systems and ambient sounds. This choice can result in temporary or permanent hearing loss due to rounds fired or blast events, which renders an operator unable to detect



ambient noises such as cracking twigs or rounds being chambered. This results in a loss of situational awareness and communication ability. SF operators are currently issued a tactical communications headset that includes wires running between the head and body components. Gentex Corporation is developing a wireless headset to enable rapid donning/doffing, reduce spare part/replacement costs due to damaged wires, and alleviate accidental loss of hearing protection due to entanglement with other SF clothing and equipment. The system will provide impulse suppression, passive attenuation, and hear-through while maintaining a secure audio communications link with a National Security Agency approved security and encryption capability.

Micro-LTE Single Channel Device

Use of unmanned aircraft systems (UAS) to observe or collect video of specific targets/areas has proven to be a valuable tool in a wide variety of field operations. However, the camera feed is only visible by those at the control station. Field operators must rely on critical information being relayed to them from those observing the feed.



Raytheon Blackbird Technologies is developing the Micro-LTE Single Channel Device which will provide not only the ground control station but also field personnel a common operating picture via their cellular devices such as phones and tablets. The Micro-LTE Single Channel Device is a small device designed for quick and easy installation into Tier 1 class UAS that will use the commercial 4G LTE cellular network as well as a private 4G LTE cellular network controlled by the end user to send encrypted video data to field operator's cellular devices. The system is being designed to use its own power supply which will last approximately two hours and be capable of providing video data to at least 8 users. The

design will be compatible with commercial-off-the-shelf 4G LTE smart cellular devices and will be ruggedized to withstand the same environmental conditions as the UAS is stored and operated in.

MEMBERSHIP

Intelligence Community

U.S. Capitol Police

U.S. Department of Commerce

- National Institute of Standards and Technology
- Office of Law Enforcement Standards

U.S. Department of Defense

- Defense Threat Reduction Agency
- Joint Personnel Recovery Agency
- Pentagon Force Protection Agency
- Rapid Reaction Technology Office
- U.S. Air Force
 - Office of Special Investigations
- U.S. Army
 - Criminal Investigation Command
 - Joint Trauma Analysis and Prevention of Injury in Combat
 - Medical Research and Material Command

- Natick Soldier Systems Center
- Program Executive Office Soldier
 - Soldier Protection and Individual Equipment
- Research, Development, and Engineering Command
- Research Laboratory
- Tank Automotive Research, Development, and Engineering Center
- U.S. Navy
 - Naval Air Systems Command
 - Naval Criminal Investigative Service
 - Office of Naval Research
 - Program Executive Office, Ships
- U.S. Special Operations Command
 - Army Special Operations Command
 - Marine Corps Forces Special Operations Command

U.S. Department of Energy

U.S. Department of Homeland Security

- Customs and Border Protection
- Federal Air Marshal Service
- Federal Law Enforcement Training Center
- U.S. Secret Service
 - Special Services Division, Technical Security Division

U.S. Department of Justice

- Federal Bureau of Investigation
- National Institute of Justice

U.S. Department of State



U.S. Army photo by Sgt. Richard Andrade

PHYSICAL SECURITY

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FOCUS AREAS

Blast Effects and Mitigation

Evaluate blast threats and develop anomaly detection and mitigation approaches to protect groups of personnel, facilities, installations, and venues. Develop decision support tools and technical solutions related to blast effects.

Screening, Observation, Detection, and Protection

Develop technologies and techniques to protect personnel in facilities, and infrastructure, by improving situational awareness; detecting, identifying, and locating threats; and, controlling access to critical assets. Emphasize automatic threat detection/alerting.

Maritime Security

Develop technologies to protect ships, ports, shore and offshore facilities. Develop sensors and devices for detection and tracking; physical barriers; and stopping devices.



Subterranean Activities

Develop capabilities to detect, locate, map, monitor, survey, and disrupt subterranean infrastructure and activities in permissive and non-permissive environments.

COMPLETED PROJECTS

Modular Air Droppable Force Protection Kit

The Modular Air Droppable Force Protection Kit (MADFPK) is a force protection system that can be packaged into one container and air dropped into austere locations. Weighing 150 pounds, MADFPK is the first air-deliverable, expeditionary force protection kit that small units can operate in remote terrain, independent of infrastructure support. The MADFPK can be operated by a single person using the control station to display the feeds from multiple mini-radar component systems, providing 360-degree situational awareness within minutes for small compound perimeter security, as well as security for dismounted operations outside of a compound. The kit can be used either wirelessly or as a wired system using Cat 5 cables. It can detect personnel out to one kilometer and vehicles out to 1.5 kilometers, while providing perimeter intrusion alerts out to 500 meters. The modular system integrates a number of capabilities, including mini-radar, wire break alerts, and camera systems with electro-optic/infrared capabilities. It contains a Power over Ethernet (PoE) adaptor, Ethernet and serial plugs, charger, solar panels, and Wi-Fi capability, and can operate for 12 hours on a single charge. The MADFPK system can also record alerts/events and has multi-speed video playback.



Scenario and Target Relevant Explosive Equivalency Tool

Data on the explosive equivalence of various materials (relative to a baseline such as trinitrotoluene (TNT)) is contained in numerous published sources from various agencies spanning four decades. Most recently, tests have focused on homemade explosives (HMEs) favored for use by terrorists, criminals, and non-state actors. However, potential users have lacked a single, consistent, unified source that provides streamlined access to this body of data along with authoritative guidance that can be used for design purposes. Further issues arise due to the fact that government manuals have published scalar equivalence values, whereas the data shows strong dependencies between equivalence and standoff distance.

Developed under a bilateral effort with the Future Systems and Technology Directorate, Singapore Ministry of Defence, the Scenario and Target Relevant Explosive Equivalency Tool (STREET) will guide users through a stepwise process of defining the explosive material and scenario. The blast design community will benefit from range-dependent equivalence values along with uncertainty



bounds to achieve a desired level of conservatism when using the tool to assist them in designing structures for blast mitigation. The community of chemists and physicists involved in explosives research will further benefit from a well-organized database of experimental equivalence data that can be augmented as further testing is conducted. Equivalence is provided in terms of pressure or impulse (for standoff scenarios) or brisance (for contact scenarios).

CURRENT PROJECTS

In-Tunnel Surveillance System

Both United States Customs and Border Protection and military units have limited capabilities when using ground robotics for underground tunnel reconnaissance. Ground robots have a limited operating range when used in either a tethered or wireless mode and have difficulty navigating water, rocks, and other obstructions and debris commonly found in subterranean tunnels. The In-Tunnel Surveillance System is a hovering robotic platform that can safely conduct reconnaissance of tunnels and routine inspections of underground municipal infrastructures. The system will be capable of autonomous hovering navigation within subterranean structures while avoiding ground obstructions. It will be self-propelled and capable of non-line-of-sight operation while avoiding collisions in both autonomous and user-controlled modes. The system will have the ability to automatically navigate a predetermined path or distance, or an unknown path by sensing its environment and self-directing without operator intervention.



It will have the ability to vertically take off, hover, and land within the structure and will provide video of sufficient resolution to enable the operator to identify a disturbance or irregularity to underground municipal infrastructure or encountered objects, potential hazards, and challenges within the tunnel. The stand-alone command and control system will allow a single person to control all aspects of system navigation and shall enable the operator to simultaneously view sensor data and the system's location within the tunnel on the same screen. The platform will be capable of carrying imaging sensors, lighting, and communication subsystems, and will provide a mapping capability to keep operators out of unknown subterranean tunnels until proven safe to enter.

Combat Diver Navigation Module

With the advent of advanced diver propulsion systems, it is critical that military divers maintain heads-up situational awareness while accurately navigating underwater at increased speed to their target. Leveraging previously developed technology, Naval Surface Warfare Center Panama City Division is completing design, development, and manufacture of an advanced prototype Combat Diver Navigation Module (CDNM) based on specific requirements

from the U.S. and U.K. military diver communities. The prototype design comprises a low-power, passive matrix organic light emitting diode micro display with custom-designed optics.





The micro display uses red characters to reduce light signature and preserve operator night vision. An electronic compass, depth sensor, battery, and microprocessor are integrated into an external housing mounted to the right side of a low volume dive mask, with an adjustable position display. The CDNM runs on a single lithium battery and the diver can control navigation functions, elapsed time, and the display's brightness. The CDNM prototypes are currently undergoing initial operational evaluations by both U.S. and U.K. military divers.

Enhanced Vehicle Explosion Analysis Software Mobile Application

Terrorists, political dissidents, and criminals use vehicle-borne improvised explosive devices (VBIEDs) in a wide variety of scenarios. VBIEDs pose a threat in both peacetime and wartime, domestically and abroad, as evidenced in the World Trade Center, Oklahoma City, and Khobar Towers bombings. In these and other terrorist attacks, VBIEDs were used to kill U.S. citizens or military personnel, destroy U.S. property and overseas Embassies, or disrupt U.S. national security operations. To assist investigators responding to a VBIED investigation, the Vehicle Explosion Analysis Software (VeXAS) was created by the Bureau of Alcohol, Tobacco, Firearms and Explosives with the help of the Technical Support Working Group and our international partners in 2013. VeXAS used algorithms based on VBIED tests to estimate scatter patterns of debris. The software assisted users in focusing their search for evidence in the most likely locations, helped them document the evidence once found, and create a virtual layout of the post-blast scene.

Under a bilateral effort with the Future Systems and Technology Directorate, Singapore Ministry of Defence, the Enhanced VeXAS program is updating and upgrading the existing software as well as packaging it into a mobile application. This will enable first responders and investigators to more expeditiously, effectively, and efficiently process a post-blast scene. The Enhanced VeXAS mobile app will help users to determine the amount of explosive used and the size of the debris field. Additionally, it will allow the user to collect and tag evidence via pictures and to export all data to the computer-based software for further analysis and use during legal prosecutions.



Explosive Testing of Unmitigated and Mitigated Brick Tunnels

Construction of underwater railway tunnels began in the U.S. in the late 19th and early 20th centuries. Many of these early tunnels, constructed of brittle materials such as cast iron and unreinforced masonry, are still in use. While these cast iron and unreinforced masonry tunnels have demonstrated their as-designed utility as stable and robust compression ring structures, they were not designed to resist extreme loads, such as near-contact detonation of a high explosive material. In the 21st century these underwater tunnels have become prime targets for terrorists. A catastrophic underwater tunnel system failure from a terrorist attack would result in extensive flooding and human casualties. The U.S. Army Engineer Research and Development Center (ERDC) in Vicksburg, Mississippi, and Lawrence Livermore National Laboratory (LLNL) are the leading applied research organizations leveraged by the Department of Homeland Security to investigate solutions to address this challenging problem. Building on previously conducted tests done on cast iron tunnels, ERDC and LLNL are conducting unmitigated and mitigated masonry subscale testing and modeling, including full-scale



blast tests on a portion of a mitigated unreinforced masonry tunnel. The initial effort has focused on subscale tests of unmitigated brick tunnels to define potential vulnerabilities and validate numerical approaches to predicting these vulnerabilities. A second set of subscale tests and predictions will then be executed to address certain mitigation strategies for masonry tunnels. The knowledge gained from the subscale analyses will then inform full-scale experiments of a masonry tunnel with mitigation. As had been done with the cast iron study before, this comprehensive experimental and numerical study of the masonry and mitigation will build confidence in the development and deployment of internal mitigation strategies for future construction of masonry tunnels and other critical transportation structures.

Next Generation Port Security Barrier

Waterside security is one of the Chief of Naval Operations' priorities for force protection. The current Port Security Barrier (PSB) is part of a class of barriers referred to as net-capture or Type I barriers. Fleet experience with this PSB design has yielded recommendations for a next generation Type II barrier. Through CTTSO, the Navy is testing and evaluating a commercial-off-the-shelf water barrier system manufactured by HALO Maritime Defense Systems that provides increased protection against small boat attacks in a reduced footprint and at a lower lifecycle cost.

HALO system configurations and mooring plans can be tailored to the force protection goals of the customer. Configurations typically include a combination of a static double-wall barrier and a remotely operated gate and barrier.

A HALO system consisting of a 300-foot Guardian™ gate attached to two Sentry™ support platforms is undergoing a long-term, operational and environmental test and evaluation at Norfolk Naval Station, Virginia. Over an eight-month period spanning fall and winter weather conditions, testing will include monthly evaluations of: semi-automated gate opening and closing capability; system resilience, structural integrity, and connection strength; and, effects of the natural environment, waves, and currents on HALO system components. Data collection from this test will inform a major Navy acquisition decision on Type II barriers for maritime force protection of critical assets at domestic and overseas bases.





MEMBERSHIP

American Society for Testing and Materials

Environmental Protection Agency

Federal Reserve Board

General Services Administration

Intelligence Community

National Reconnaissance Office

State and Local Agencies

- DC Metropolitan Police Department
- DC Protective Services Police Department
- New York Police Department
- Port Authority of New York and New Jersey
- Virginia Department of Transportation

U.S. Capitol Police

U.S. Department of Commerce

- National Institute of Standards and Technology

U.S. Department of Defense

- Defense Advanced Research Projects Agency
- Defense Intelligence Agency
- Defense Threat Reduction Agency
- Explosives Safety Board
- Joint Chiefs of Staff
- Joint Improvised-Threat Defeat Agency
- Joint Non-Lethal Weapons Directorate
- Joint Task Force North (NORTHCOM)
- Joint Warfare Analysis Center (JFACOM)
- National Ground Intelligence Center
- Office of the Secretary of Defense
- Physical Security Enterprise and Analysis Group
- Unified Combatant Commands
- U.S. Air Force
 - Research Laboratory

- U.S. Army
 - Armament Research, Development, and Engineering Center
 - Army Research Laboratory
 - Asymmetric Warfare Group
 - Communications-Electronics Research, Development and Engineering Center
 - Corps of Engineers
 - Engineer Research and Development Center
 - Office of the Provost Marshal General
 - Night Vision and Electronic Sensors Directorate
 - Rapid Equipping Force
 - Research, Development, and Engineering Command
 - Training and Doctrine Command
- U.S. Marine Corps
 - Central Command
 - Systems Command
 - Warfighting Laboratory
- U.S. Navy
 - Chief of Naval Operations
 - Commander Navy Installations Command
 - Expeditionary Combat Command
 - Naval Criminal Investigative Service
 - Naval Explosive Ordnance Disposal Technology Division
 - Naval Facilities Engineering Command
 - Naval Facilities Engineering Service Center
 - Naval Sea Systems Command
 - Office of Naval Research
 - Strategic Systems Programs
- U.S. Special Operations Command
 - Army Special Operations Command
 - Army Special Forces Command (Airborne)

- Joint Special Operations Command
- Marine Corps Forces Special Operations Command
- Naval Special Warfare Command
 - Naval Special Warfare Development Group

U.S. Department of Energy

- Federal Energy Regulatory Commission
- National Nuclear Security Administration
- Nuclear Regulatory Commission

U.S. Department of Homeland Security

- Customs and Border Protection
- Federal Protective Services
- Immigration and Customs Enforcement
- Science and Technology Directorate
- Transportation Security Administration
- Transportation Security Laboratory
- U.S. Coast Guard
- U.S. Secret Service

U.S. Department of the Interior

- Bureau of Reclamation

U.S. Department of Justice

- Bureau of Alcohol, Tobacco, Firearms and Explosives
- Drug Enforcement Administration
- Federal Bureau of Investigation
- Federal Bureau of Prisons
- U.S. Marshals Service

U.S. Department of State

- Bureau of Diplomatic Security

U.S. Department of Transportation

- National Transportation Systems (Volpe Center)



SURVEILLANCE, COLLECTION, AND OPERATIONS SUPPORT

scossubgroup@cttso.gov

FOCUS AREAS

Biometrics, Recognition, Identity Intelligence, Tracking, and Exploitation (BRITE)

Improve technologies to identify and/or mask entities of interest using or countering biometrics, pattern recognition, database technologies, and exploitation methodologies.

Cyber and Convergence Technologies

Support or improve technologies for cyber and signals collection as these technologies increasingly converge with other systems and technologies to include, but not limited to the “Internet of Things.”

Human Language Technology (HLT) and Media Exploitation

Develop and employ HLT where these technologies can best assist humans – operators and analysts – to make sense of volume and the variety of language media sources; apply timely and actionable intelligence in theater; and enhance communication skills and cultural understanding.



Surveillance/Counter-Surveillance

Develop audio, video, and advanced surveillance technologies, as well as automated tools and techniques to defeat adversarial tactics, techniques, and procedures (TTPs) and methodologies.

Technical Collection/Special Communications

Improve ISR by developing and enhancing multi-INT sensors, SIGINT collection, and tagging tracking, locating technologies for intelligence operations. Develop and enhance special communications and canine advanced technologies in support of Special Operations and intelligence collection activities.

COMPLETED PROJECTS

Filtering Language, Audio, and SMS Human Language Technologies

The use of electronic warfare systems poses unique challenges in processing the variety of data sources that these systems ingest. Thus, enabling the operator to quickly understand the tactical environment with automated tools is critical. Filtering Language, Audio, and Short Message Service (SMS) with Human Language Technologies (FLASH) provides tools for data exploitation including speech activity detection, language, gender, and speaker identification.



Tactical Canine Casualty Care Veterinary Emergency Trainer

Military Working Dog (MWD) Handlers and Medics strive to follow the tenets and procedures of Tactical Combat Casualty Care (TCCC), such as Care Under Fire, Tactical Field Care, and Tactical Evacuation Care as it is linked to the components of the MWD Handler First Aid Kit. To that end, MWD Handlers and Medics have a critical requirement for realistic and affordable training aids. Valid alternatives to live tissue or cadaver training are needed in response to the 2013 National Defense Authorization Act (NDAA) and for use at locations unable to support live tissue training events. The Tactical Canine Casualty Care Veterinary Emergency Trainer (TC3-VET) is a realistic canine trainer which provides hands-on, interactive, and realistic training that can help save the lives of not only military dogs, but also canines.

MEMBERSHIP

Intelligence Community

Special Operations Forces

U.S. Department of Homeland Security

- Customs and Border Protection
- Homeland Security Investigations

U.S. Department of Justice

- Federal Bureau of Investigation



TACTICAL OPERATIONS SUPPORT

tossubgroup@cttso.gov

FOCUS AREAS

Offensive Systems

Develop advanced equipment and capabilities that enhance the effectiveness of small tactical units engaged in direct action operations. Develop specialized weapons, munitions, detonators, distraction/diversion devices, and other unique tactical equipment.

Unconventional Warfare and Counter-Insurgency Support

Develop advanced tools and equipment specifically for small tactical units conducting a broad spectrum of military, paramilitary, special warfare, and digital operations focused on force protection, assisted and unassisted recovery, and operational preparation of the environment.

Tactical Communications

Develop flexible, enhanced, full spectrum open communications capabilities specifically designed for tactical forces, with emphasis on reducing operational load while improving operator mobility and efficiency. Develop assured tactical communications connectivity in challenging environments such as complex urban, subterranean, and maritime.



Tactical Reconnaissance, Surveillance, and Target Acquisition Systems

Develop technologies to assist small tactical teams in conducting organic reconnaissance, surveillance, and target acquisition missions. Develop systems that enhance the visual perception and other imaging capabilities of tactical operators in all conditions and environments.

Specialized Infiltration, Access, and Exfiltration Systems

Develop technologies that assist tactical assault forces in gaining rapid insertion, access and egress to and from objectives. Improve evaluation of tactical options, support efficiency and stealth, including remote operations. Develop enhanced target analysis, manual and dynamic breaching technologies for small tactical assault teams.

Survivability Systems

Develop man portable tools and equipment to enhance operator survivability during the conduct of tactical missions.

COMPLETED PROJECTS

Enhanced Mortar Targeting System – Mobile



United States Special Operations Forces (SOF) deployed to high threat locations around the globe require an organic, highly accurate, rapid, and mobile indirect fire capability for force protection. The Enhanced Mortar Targeting System (EMTAS) – Mobile incorporates a state-of-the-art enhanced ballistic computer with an 81mm mortar integrated on a highly mobile

light commercial vehicle with enhanced suspension. The entire system is provided as a kit to allow for quick installation and sustainment in OCONUS austere environments. With only two operators, the EMTAS – Mobile is ready to fire in less than 45 seconds, delivering lethal consequence to the enemy, 360 degrees, delivering 10 rounds a minute out to 5.5 kilometers with a circular error probability of two percent. The EMTAS – Mobile provides SOF and host nation partners with a highly accurate, highly mobile, and low-visibility indirect fire support platform that improves small unit survivability while minimizing the risk of collateral damage.

EMTAS – Mobile was jointly developed by industry partners Elbit Systems of America and Praevius Group, Inc.; and U.S. Government partners Army Rapid Equipping Force, Army Test and Evaluation Command, Product Manager for Guided Precision Munitions and Mortar Systems (PdM GPM2S), Army Armament Research, Development and Engineering Center (ARDEC), and Naval Surface Warfare Center, Hawthorne. U.S. SOF will conduct CONUS and OCONUS operational evaluations in FY16.



Tactical Tethered Hovering Aerial ISR – Mobile

The Tactical Tethered Hovering Aerial ISR (TTHAISR) – Mobile provides an organic, mobile, rapidly deployable/re-deployable tethered ISR-capable platform that can be launched to a maximum altitude of 165 feet. The TTHAISR – Mobile has an EO/IR gimballed camera payload that provides friend or foe, day/night target position/location through

an integrated secure mobile ad-hoc mesh radio network, serving as a communications relay that passes critical ISR to small tactical units and higher headquarters. Systems developed are mobile, low visibility in transport, and mounted on nonstandard vehicles, but can also be integrated onto other ground and maritime platforms allowing for use in high threat, unsupported, and austere operating environments. TTHAISR – Mobile was jointly developed by industry partners Stark Aerospace, Inc., Sky Sapience, Ltd., Analytical Methods, Inc., CONTROP USA, Inc., and Persistent Systems, LLC. Three systems have been delivered to U.S. SOF for CONUS and OCONUS operational evaluations in FY16.



CURRENT PROJECTS



HERO30-SF Lethal Miniature Aerial Munition System

SOF requires a tactical surgical strike capability organic to small teams operating in high threat areas when fire support assets are limited or non-existent. The HERO30-SF is a man-packable canister launched lightweight Lethal Miniature Aerial Munition System (LMAMS) that significantly improves first round hits to over 90 percent and reduces collateral damage in support of operations in urban environments

and challenging terrain. The HERO30-SF can launch from its portable canister and go directly to the intended target, or conduct intelligence, surveillance, and reconnaissance (ISR) until the operator identifies a target allowing the operator to find, fix, and finish targets of opportunity. The HERO30-SF, developed jointly by Mistral, Inc. and UVision, allows engagement of enemy combatants without exposing the SOF operator to direct enemy fires, allowing time sensitive targeting of line of sight (LOS) or beyond line of sight (BLOS) stationary or moving targets.



SOF Advanced Ballistic Engine and Rangefinder

Tactical operators conducting surgical strike missions require a weapon-mounted, altitude density calibrated, ballistic-engine driven laser rangefinder. The SOF Advanced Ballistic Engine and Rangefinder (SABER) system maximizes the shooter's ability to successfully interdict hostile targets at increased ranges when using issued 5.56 mm and 7.62 mm weapon systems. As the shooter acquires his target, he has access to relevant variables for the firing solution without taking his eyes off target, reducing the time penalty

in the kill chain and expended ammunition to solve the problem. SABER was developed by Wilcox Industries Corporation.



Extendable Micro Camera Capability

Tactical operators require a day/night, assembled to fit, man-portable camera system capable of remotely viewing targets of interest in real time. The Extendable Micro Camera Capability (EMC²) provides an enhanced situational awareness capability in confined spaces to search under doors, around corners, in between interior and exterior walls, fences, through substructure pipes, and duct work. Designed to be easily and quietly deployed and quickly recovered, the EMC² provides small tactical teams improved confined space infil-planning and surveillance for close quarter battle, hostage rescue, and counterterrorism missions. EMC² was developed by AMP Research, Inc. Five kits will be provided to DoD and interagency tactical units for operational evaluation in FY16.

Man-Portable Aerial Radar System – Kit

The Man-Portable Aerial Radar System - Kit (MARS-K) is an advanced dual mode, man-packable, easily deployed radar that provides small tactical units with the organic capability to detect and track small unmanned aircraft systems and ultra-light aircraft, as well as detection and tracking of personnel and vehicle ground targets. MARS-K incorporates mature, cutting edge radar technologies at a significantly reduced size and weight with enhanced communications and control hardware to give the operator early warning to mitigate emerging threats. MARS-K is a game changing situational awareness tool for small tactical units deployed in austere environments for force protection and counter-UAS operations, greatly increasing operator battlefield survivability. MARS-K was developed by ELTA North America and two kits will be provided to interagency tactical units for operational evaluation in FY16.



Maritime Canister Launched Small Unmanned Aircraft System

Small tactical units operating in maritime environments lack an organic small unmanned aircraft system capable of being deployed, controlled, and monitored while submerged to support surface surveillance and reconnaissance missions. The Maritime Canister Launched Small Unmanned Aircraft System (MCLSUAS) provides SOF maritime forces the ability to launch a collapsible-wing unmanned air vehicle (UAV) in sea state 3 conditions from a canister system that is capable of both launch and reuse after recovery. The battery-powered, small tactical UAV is capable



of transmitting intelligence, surveillance, and reconnaissance (ISR) data via a floatable and tethered NSA Suite B secure mobile ad-hoc mesh radio network integrated to either a host underwater platform or an underwater capable ground control station. The air vehicle has a minimum operating time of 70 minutes and is capable of 50 knots dash speed and stall speeds of 15 to 20 knots. The UAV is designed to stay afloat for a minimum of 30 minutes for recovery and reuse. The MCLSUA is being developed by Lockheed Martin and will be ready for maritime operational evaluation in FY17.

Miniature Gimbal Laser Target Designator Payload for Small Unmanned Aircraft System

Small tactical teams require a next generation stabilized gimbal payload that integrates long wave infrared (LWIR) technology, see-spot, and laser target designator that can be used on small unmanned aircraft system (sUAS) category of aircraft such as Raven, Wasp, Arrowlite, and Puma. When fielded, small tactical teams will have the capability to immediately transition from intelligence, surveillance, and reconnaissance (ISR) to a targeting role using the same payload with a state-of-the-art laser marking/designating and spot confirmation capability to accomplish find, fix, finish, exploit, and assess tasks. This effort is under joint development by CONTROP USA, Inc. and Avwatch, Inc. and will be available for operational evaluation in FY16.



GreenZone Tactical Communications



Tactical operators require secure and discrete communications for special warfare. The GreenZone Tactical Communications capability features a complete system on a chip via a microSD card. The capability, a joint effort with GreenZone Systems, Inc., SAIFE, Inc., and CyberReliant Corporation, also features the use of a global network for trusted routing and verified end-to-end communications. The GreenZone Tactical Communications project endeavors to bring government communications into the 21st century by

allowing the use of Android smartphone devices through an approved for use hardware, software, and encryption architecture. By implementing security at the hardware, software, and telecommunications level, the GreenZone Tactical Communications capability significantly improves communications security and surety for a multitude of communication needs. DoD and interagency tactical units will receive final production kits for operational evaluations beginning in FY16 through FY17.

Military Free Fall Tactical Tool

Special Operations Forces conducting Military Free Fall (MFF) operations require an improved and advanced compact and modular navigation board that uses digital and analog technology for optimal and efficient situational awareness, ability to navigate accurately in all conditions, and ability to standardize MFF training and operations. The Military Free Fall Tactical Tool (MFF-T2) provides the ability for the operator to customize their individual and team boards, allowing each parachutist the ability





to quickly view and operate their GPS, compass, and other navigation tools during high altitude high opening (HAHO) MFF operations. The MFF-T2 is a durable anti-shock kit that is also resistant to warping, corrosion, UV light, and general defects resulting from common contaminants and corrosives. The MFF-T2 consists of an Android based situational awareness tool capable of full motion video viewing, blue force tracking, telestration, and person-to-person chat; thus, enhancing tracking and the MFF teams' ability to communicate under canopy. Forty-eight kits will be provided by ADI Technologies, Inc. and Juggernaut Defense, LLC to DoD and interagency tactical units for operational evaluation in FY16.



Multi-Role Thermal Survivability System

Small tactical teams operate in hot austere environments where temperatures can reach triple digits. Wearing body armor and other protective gear in extreme heat puts operators at high risk for dehydration, heat stress related injuries, and degraded cognitive function. The Multi-Role Thermal Survivability System (MRTSS) actively cools the tactical operator's body and reduces the risk of heat-related injuries. The system, developed by RINI Technologies, Inc., includes a lightweight cooling vest to be worn underneath the operator's combat equipment. A 3.9-pound thermal management unit (TMU) chills the water to about 72 degrees Fahrenheit and pumps it through parallel tubes in the cooling vest. The TMU is approximately the size of a one-liter bottle and is significantly smaller and uses less than half the amount of power needed by existing personnel cooling systems currently fielded and in use by U.S. Army Aviation. MRTSS can be powered by a standard military BB-2590 battery or standard A/C commercial power sources. It also has a compact wearable fast recharging system that is fully ruggedized for use when it is deployed, capable of charging the battery and operating the TMU simultaneously. The RINI cooling system reduces heat stress, maintains safe core temperature levels, and improves operator endurance and sustains cognitive functions. Three systems will be provided to interagency tactical units for operational evaluation in FY16.



Non-Pyrotechnic Diversionary Device

Current noise/flash diversionary devices (NFDD) rely on a small quantity of explosive material to create a loud noise and brilliant flash that is intended to distract and disorient adversaries during tactical operations. These NFDDs create sparks which may cause unintended explosions or fire when employed near flammable gasses or materials. The

Non-Pyrotechnic Diversionary Device developed by Applied Research Associates, Inc., provides operators with an improved and advanced, intrinsically safe means to distract and disorient adversaries in high risk/high threat hazardous environments where currently fielded standard pyrotechnic means may cause unnecessary risk or collateral damage. DoD and interagency tactical units will receive 10 final production kits and new equipment training to conduct operational evaluations in FY16.

Lightweight 5.56 mm Polymer Ammunition

While current brass-cased small arms ammunition is reliable, it adds considerable weight to already overloaded tactical operators and ground combatants. Cartridge case technology has advanced to a state of maturity allowing modern lightweight polymers to be used in the construction of hybrid 5.56 mm cartridges that weigh as much as 31 percent less overall than legacy brass-cased 5.56 mm cartridges. This reduces the weight of the standard ammunition combat load of



an M249 SAW gunner from 20 to 14 pounds and that of a rifleman from 5.6 to 3.9 pounds. This bilateral effort with the United Kingdom challenged industry to develop and deliver polymer-cased ammunition that will function in unmodified, in-service carbines and belt-fed light machineguns in extreme environments. Phase I deliverables have met both threshold and objective weight reduction goals and passed extreme temperature testing from -65°F to 165°F. Technical testing of lightweight polymer rounds produced by MAC, LLC, located in Bay Saint Louis, MS, will continue in FY16. U.S. DoD, Interagency, and U.K. evaluations will be conducted throughout FY16.

Lightweight Intermediate Caliber Cartridges

The Lightweight Intermediate Caliber Cartridges (LICCs) requirement challenges industry to develop lightweight conventional-configuration combat cartridges that would operate as normal in traditional carbines, rifles, and belt-fed machine guns while also providing extended maximum effective range (greater than 300 meters) and terminal effects on targets beyond current U.S., NATO, and threat weapon capabilities. Using joint United States and United Kingdom salient performance specifications compiled during two CTTSO conducted workshops, the U.S. Army Marksmanship Unit developed two intermediate caliber cartridges in both 6.5 mm (.264") and 7 mm (.277") calibers that have been used for the basis of the LICCs project.



Industry provided technical solutions that would reduce the weight of the 264 U.S.A and 277 U.S.A. LICC rounds by 28 to 31 percent. Phase II deliverables include 2,500 rounds of both calibers in three assorted loads that will be tested in FY16 to generate data to support and inform ongoing United Kingdom and Canada caliber studies, and the U.S. Army Small Arms Ammunition Configuration (SAAC) Study. The SAAC Study is focused on defining the optimum common caliber and cartridge for the next generation of small unit weapon systems for Army and SOF warfighters use in 2020 and beyond. U.S. DoD, Interagency, and U.K. evaluations will be conducted throughout FY16.

Next Generation Small Arms Signature Reduction

The next generation suppressor for the MK18 Close Quarters Battle Rifle (CQBR) and M4 carbine is designed to reduce audible, visual, and thermal signatures. This newly developed suppressor features a forward flowing design that is intended to remedy problems and shortfalls found in current fielded gas capture systems. Specifically, the new suppressor design remedies the following: increased bolt carrier speeds that induce malfunctions, increased backpressure, excess weapon fouling, and health concerns for the operator from toxic blowback. This is a U.S. and U.K. bilateral effort, being developed by Operators Suppressor Systems. Twenty systems will be developed and provided for evaluation in the U.S. and U.K. in FY16.





Cyber Operator Greyhat

Our nation continues to encounter an increasing cyber threat where a “Digital Divide” exists between the U.S. and our cyber opponents. The larger Government and military organizations are standing up capacities and capabilities to address this threat at the strategic level. At the request of SOF, CTTSO has taken the initiative to complement this larger build by training operators at the tactical level. Cyber Operator Greyhat (COG) is an unclassified, open source digital operations course tailored to train tactical operators to understand the cyber domain and to identify and mitigate

cyber threats. The five-week intensive course provides foundations in computer science, information security, social media, social engineering, and advanced computer networking. This classroom instruction is validated through practical field training events and one comprehensive full mission profile, three-day culmination exercise. Tactical operators trained at COG return to their units as trainers in cyber tactics, techniques, and procedures. The Digital Domain will become key terrain on future battlefields. Advanced Mission Systems and SensePost Pty. Ltd. jointly developed and deliver this curriculum. COG contributes to the development of SOF tactical capabilities build for 21st century Special Warfare cyber enabled operations and will train over 180 SOF, DoD, interagency, and select international partner operators through FY17.



Cyber Operator - Social Media/Open Source Intelligence

Protection against the current and increasing digital threat requires special skills to understand and operate in the digital battle space. The 21st century social media medium is being leveraged and exploited by state and non-state actors to recruit, command, control, and conduct illegal and terrorist activities against U.S. and allied interests. Cyber Operator - Social Media/Open Source Intelligence (COSMO) is a three-week intensive, tactical level training course that teaches operationally relevant capabilities to execute 21st century Special Warfare mission sets. COSMO teaches the tactical edge operator proven methodologies that are based on best practices, tactics, techniques, and procedures. The course introduces state-of-the-art social

media tools against operationally relevant themes, exploiting publicly available social media information. The training program is designed to enhance organic tactical unit digital force protection, digital identity management and digital operational preparation of the environment capabilities for special operators. COSMO is conducted with managed attribution in a global environment. By design, COSMO is conducted in a unique, combined, joint, interagency digital task force competitive environment that will train over 180 SOF, DoD, interagency, and select international partner operators through FY17.

Underwater Vision Enhancement

The Underwater Vision Enhancement (UVE) device allows Explosive Ordnance Disposal (EOD) and combat divers the ability to perform render safe procedures at night and in reduced visibility conditions. The UVE device interfaces with the standard Navy Mk20 dive mask and provides the diver a hands-free capability to conduct hull/maritime structure search/inspection in both clear and turbid water without the use of an external light source while also enhancing vision above the water line. The UVE uses a combination of cutting edge sensor, display, and software technologies to provide the first all-digital and dive ready night vision device that gives the diver a large field of view and higher resolution. UVE is being developed by AMP Research, Inc. DoD, interagency, and select international partner dive units will receive a total of 15 production kits and new equipment training to conduct maritime operational evaluations in FY16.



MEMBERSHIP

National Tactical Officers Association

State and Local Agencies

- Austin (TX) Fire Department
- Boston (MA) Special Weapons and Tactics
- Charleston (SC) Special Weapons and Tactics
- Denver (CO) Special Weapons and Tactics
- Indianapolis (IN) State Police Bomb Squad
- Los Angeles (CA) Police Department
- Los Angeles Sheriff's Department
- Maryland State Police Special Weapons and Tactics
- Massachusetts State Police Bomb Squad
- New Jersey State Police
- New York Police Department and Fire Department
- Pasco County (FL) Sheriff's Office
- San Diego (CA) Sheriff's Department
- San Diego Fire Department and Bomb Squad
- Savannah (GA) Special Weapons and Tactics
- South Carolina State Police Bomb Squad
- South Carolina State Police Special Weapons and Tactics

U.S. Department of Defense

- Cyber Command
- Defense Intelligence Agency
- Joint IED Defeat Organization
- Joint Personnel Recovery Agency
- National Guard Bureau
- National Security Agency
- U.S. Air Force
 - Explosive Ordnance Disposal
- U.S. Army
 - 20th Support Command, CBRNE
 - Armament Research, Development, and Engineering Center

- Asymmetric Warfare Group
- Maneuver Center of Excellence
- Night Vision and Electronic Sensors Directorate
- Office of the Army G-3/5/7 (Operations/Plans)
- Office of the Army G-8 (Financial Management)
- Program Executive Office Soldier
- Rapid Equipping Force
- Soldier Systems Center
- U.S. Marine Corps
 - Explosive Ordnance Disposal
 - Marine Corps Forces Cyber Command
- U.S. Navy
 - Naval Academy
 - Naval Air Weapons Station, China Lake
 - Naval Postgraduate School
 - Naval Surface Warfare Center, Carderock Division
 - Naval Surface Warfare Center, Crane Division
 - Naval Surface Warfare Center, Dahlgren Division
 - Navy Explosive Ordnance Disposal Group 2
- U.S. Special Operations Command
 - Air Force Special Operations Command
 - Army Special Operations Command
 - 1st Special Forces Command (Airborne)
 - 75th Ranger Regiment
 - Army Special Operations Aviation Command
 - Civil Affairs
 - Military Information Support Operations Command
 - U.S. Army John F. Kennedy Special Warfare Center and School
 - Joint Special Operations Command

- Marine Corps Forces Special Operations Command
- Naval Special Warfare Command
 - Naval Special Warfare Groups
 - Special Boat Teams
- Theater Special Operations Commands

U.S. Department of Energy

- National Nuclear Security Administration

U.S. Department of Homeland Security

- Customs and Border Protection
 - Border Patrol Tactical Unit
 - Border Search, Trauma, and Rescue
- Federal Air Marshal Service
- Homeland Security Investigations
- Immigration and Customs Enforcement
- Office for Bombing Prevention
- Transportation Security Laboratory
- U.S. Coast Guard
 - Maritime Security Response Team
 - Maritime Safety and Security Team
- U.S. Secret Service

U.S. Department of Justice

- Bureau of Alcohol, Tobacco, Firearms and Explosives
 - Special Response Team
- Federal Bureau of Investigation
 - Ballistic Research Facility
 - Critical Incident Response Group
 - Hostage Rescue Team
- U.S. Marshals Service

U.S. Department of State

- Bureau of Diplomatic Security



TRAINING TECHNOLOGY DEVELOPMENT

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FOCUS AREAS

Innovative Training and Educational Concepts

Research, develop, and evaluate training and educational programs that employ novel instructional design and/or delivery methods for accelerating and enhancing the acquisition of advanced knowledge and skills.

Human Performance Technology

Analyze the full range of performance gaps and select interventions to improve and sustain human performance. Develop, test, and evaluate performance improvement technologies and programs based on cognitive and physiological principles to optimize operator training and ultimately mission performance.

Mobile Learning

Design and develop intuitive, interactive learning solutions for anywhere, anytime access from mobile devices. Develop mobile applications and technology that supports learning through ubiquitous and just-in-time access to educational resources, collaborative learning environments, and user-generated content.

Immersive Learning Technology

Research and develop technology that allows a learner to seamlessly interact with, and become immersed in, a learning environment. Develop tools, technologies, and techniques for improving the design, development, and validation of interactive and immersive learning technology.

COMPLETED PROJECTS

Foreign Weapons 3D Models and Applications

The Foreign Weapons 3D Training Models and Applications are a combination of interactive 3D graphics and interactions delivered through mobile game engine technology to provide guided practice and performance support for foreign and non-standard weapon tasks. Adayana Government Group developed these models and applications to enable users to see the simulated internal operation of the weapons and manipulate those weapons in 3D as well as practice field strip and armorer level detailed disassembly, reassembly, and function checks on a highly realistic, interactive, graphical representation of each weapon. The system was delivered on PC-based browsers and mobile devices and is accessible via a personal or government-owned mobile device (i.e., smartphone or tablet) that may be connected to a government network if desired and may be used without an Internet connection. The app is currently in use at Ft. Bragg, North Carolina.



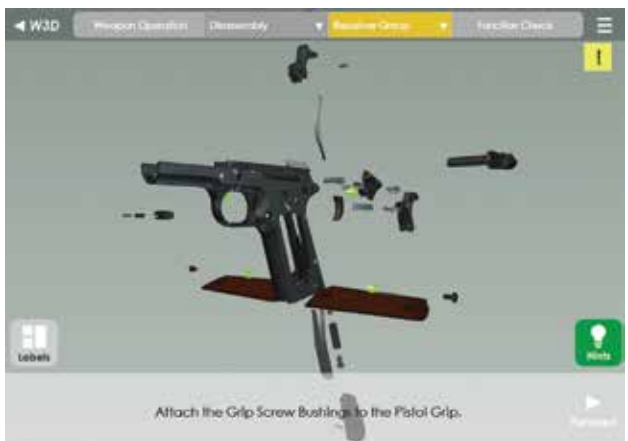
The image shows the X-ray version of an AKM, which enables the end-user to see the inner-working of the operational mechanics.



This image shows the title page of the Weapons 3D Virtual Task Trainer.



This image shows the various categories and specific tasks in the Weapons 3D module for an AKM.



This image shows a disassembled Colt 1911 with the capability to select "Labels" for every component.



IED Interactive Scenarios for Public Safety Responders

IED Interactive Scenarios for Public Safety Responders is an advanced computer/web-based training (C/WBT) package focused on enhancing situational awareness skills of first responders. It includes nine, interactive, self-paced, stand-alone scenarios for law enforcement, public safety responders, and private sector corporate security personnel, using 3D animated scenes depicting potential IED threats. Each scenario is designed to heighten first responders' awareness and reaction skills for an initial on-scene response to an IED event by posing a variety of challenges and branching options that require the user to identify precursors, changes in threat environments, and variations in threat streams. The goal is for first responders to practice what they have learned in previous training and develop their situational awareness and critical thinking skills. Adayana Government Group developed this tool to be used on a Government Learning Management System and/or a stand-alone DVD.



Image of a man wearing an IED vest in a train station.



An officer has 60 seconds to observe a crime scene for IED components.



A police officer has condoned off an area with an IED.



PSC Student conducting defensive drivers training.



PSC Student reviews the operations targeting board.



Team conducts assault on targets.

Physical Surveillance and Close Target Reconnaissance Course

Advanced Mission Systems (AMS) designed, developed, and executed the Physical Surveillance Course (PSC) in response to an operational requirement for Special Forces operators to conduct full spectrum, low-level visibility surveillance focused on an opposing threat network. More than 290 Special Forces operators have been trained on physical surveillance over the 12 iterations of the eight-week course. The comprehensive modules for this course include: basic and advanced physical surveillance operations; tactical driving; operational photography; tagging, tracking and locating; surveillance detection and route planning; basic technical surveillance; and combined surveillance techniques integration. AMS' innovative surveillance technology was tested and evaluated for incorporation into each course. Qualifying equipment was then integrated into both the curriculum and student training kits, ensuring students had experience with the most relevant and effective surveillance equipment.

At the end of each course, students were evaluated through a comprehensive one-week culmination exercise. The exercise centered upon a student led, full-spectrum surveillance operation to identify and locate the scenario's terrorist cell. Part of their objective was to prevent the cell from executing a major terrorist event in a medium to large sized city. This resource intensive exercise included the use of multiple role players, vehicles and facilities, and spanned across three primary cities. The exercise employed multiple ground, air and mass transportation platforms, and included thorough coordination with both federal and local law enforcement agencies and organizations.

Following from the success of the PSC, the Department of the Army established a Professional Development Skill Identifier to denote graduating soldier's proficiency in conducting physical surveillance activities. The United States Army Special Operations Command will sustain this course in FY16 and beyond.

Graduates of the PSC have successfully employed tactics and techniques derived from this curriculum in support of real world global contingency operations.

Augmented Reality Mobile Learning Technology Prototype

Augmented reality technology has the potential to enhance learning environments and improve the performance of our military and federal law enforcement personnel. The goal of this effort was to create a proof of concept, design, and build a successful prototype application to be evaluated for use in operational settings. Float Mobile Learning designed and developed a suite of augmented reality tools for delivery of affordable, dedicated, commercial-off-the-shelf wearable platforms such as the ODG R-6 Moverio BT-200 Smartglass product. Float Mobile Learning envisioned a bold, future-forward approach to augmenting operational environment users by creating personal assistant prototypes to assist with three primary use cases - Location Assistance, Environmental Signifiers, and Identification Assistance.



Screenshot of VIN Number Recognition



Screenshot of Facial Recognition Outcome Screen



Screenshot of Location Assistant



Screenshot of Text Translation

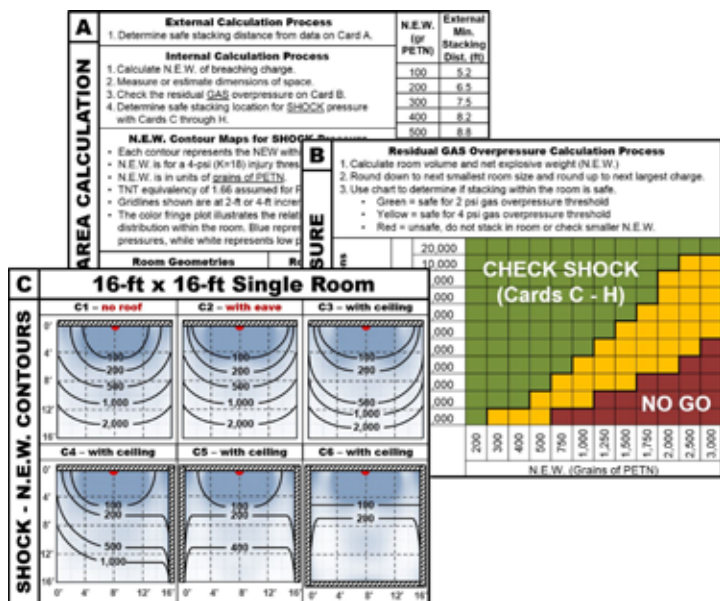


Cover for full-color instructor and student guides.

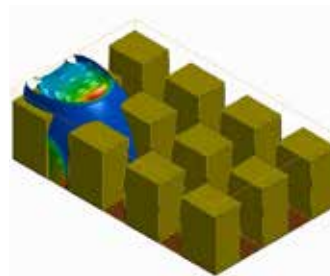
Explosive Response Overpressure and Safe Area Identification Program

Tactical breachers, military EOD, and public safety bomb technicians may be injured by deliberate or accidental detonations of explosives; however, these operators prefer to be as close as safely possible to the explosive during an operation. The existing guidance for safe standoffs was limited and did not account for several key factors, such as interior or exterior locations, charge geometry effects and tamping effects.

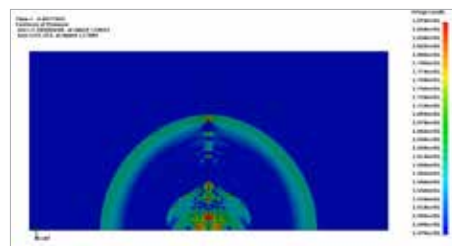
This project developed a training program to allow operators to identify safe locations where they could perform their duties with minimal risk of injury from blast and fragments. Protection Engineering Consultants (PEC) and the Energetic Materials Research and Testing Center (EMRTC) partnered to develop the Explosive Response Overpressure and Safe Area Identification training program. The curriculum included



Safe Area Calculator (SAC) pocket-reference cards for breachers to estimate overpressure in confined indoor environments.



Three dimensional animation depicting blast propagation between building in an urban canyon.



High resolution animation depicting water-tamped detasheet breaching charge.

two technical tracks for bomb squads and breachers. It included background in blast and fragment effects from IED and breaching charges, the use of novel blast effects animations for urban bomb squad and breacher settings, and instruction on how to use a pocket-reference tool, the breacher Safe Area Calculator.

Integrated Tactical Human Performance Enhancement System

The Integrated Tactical Human Performance Enhancement System effort sought to take advantage of the proliferating world of “wearables” to dramatically improve the ability of Special Operations Forces (SOF)



Quickly gain insights into training efforts through intuitive graphical representations of data.

training program administrators to optimize operator training. This was accomplished by integrating a set of fixed, mobile, and wearable physiological, cognitive, biological, and nutrition measurement devices into a proven human asset management platform. The result was a powerful platform with automated human performance data capture, centralized data storage, and an informative user interface for faster interpretation of the increased volume of data. The system reduced strain on the limited operator training administration resources while increasing their ability to gain insights into the effectiveness of operator training programs. The 75th Ranger Regiment now has unprecedented ability to optimize its operator training and maximize operator readiness.



Replace coach's clipboard with a sophisticated tablet able to automatically collect performance measurements, track assessments, and facilitate training day activities.



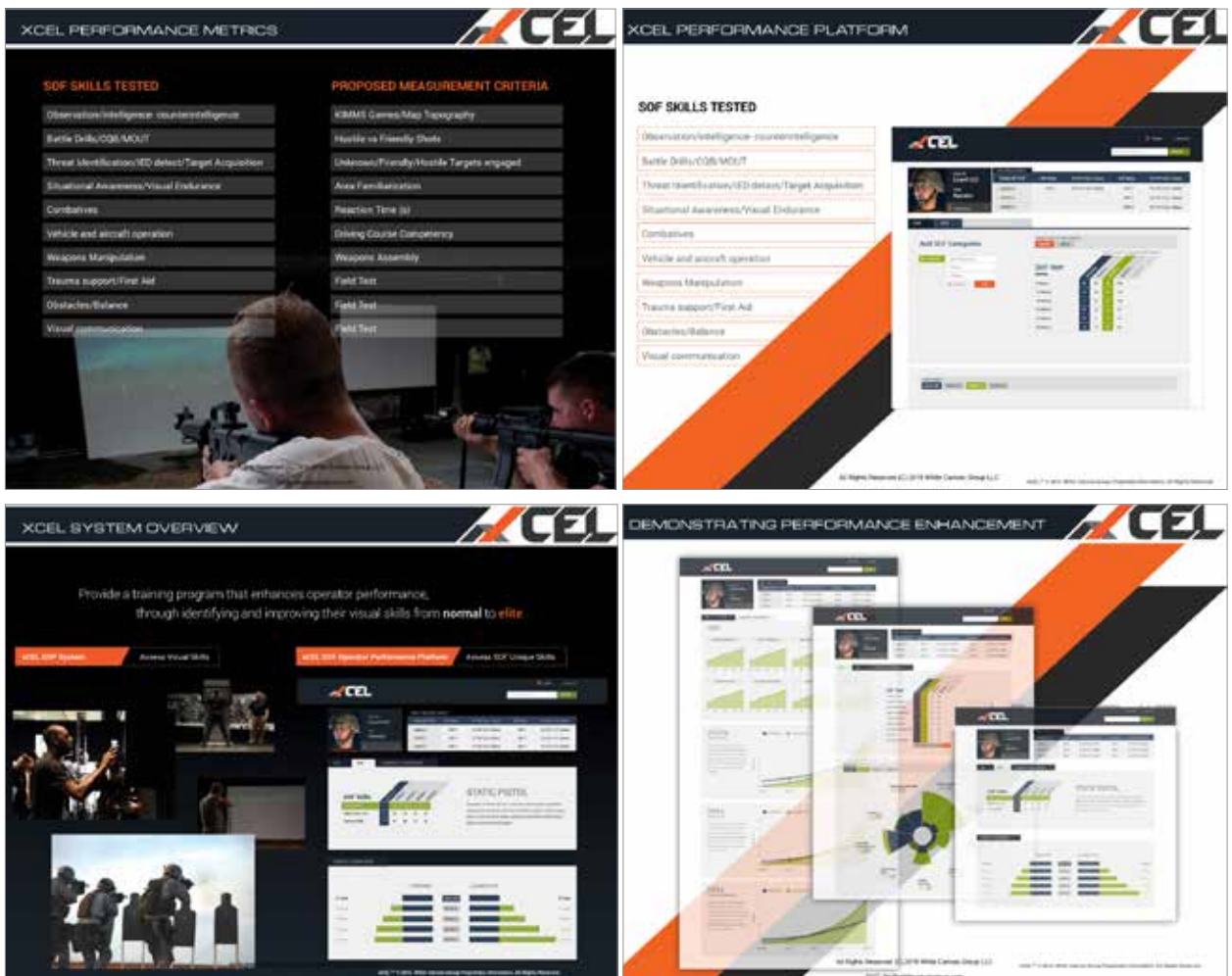
Gain actionable insights at a glance through comprehensive dashboard.



Assess factors affecting operational readiness fast with simple displays.

Project xCEL - Enhancing Sensory Performance

Elite athletes and human performance professionals have been using vision sensory performance evaluation and training regimes for several years with success. The Enhancing Sensory Performance (xCEL) project and the associated training program developed by White Canvas Group LLC, is a customizable solution that used cutting edge vision sensory technology. This technology was based on decades of science based research, investment, and training tools to elevate or predict critical skills toward levels required by Special Operations Forces (SOF) operators and elite law enforcement. By controlled research within the SEAL qualification training personnel pipeline, xCEL aimed to test and validate the hypothesis that, “by enhancing an individual’s visual sensory performance capability through advanced technology, we can positively impact that same individuals professional performance and requisite skills associated with Close Quarters Combat (CQC).” Results showed that although there were no significant treatment-control group performance differences, there were correlations between certain xCEL system, simulated shooting, and live-fire shooting measures. These correlative findings indicate that the xCEL system could be used to predict warfighter performance in several vision skill performance areas associated with CQC.





CAMX Emergency Behavior Enhancements

The result of this bilateral effort with Canada was Civilian Activity Modeling for Exercises and Experimentation (CAMX) tool enhancements to assist with site security planning. By modeling civilian health effects behavior according to a health effects model, the enhancements allow United States and Canadian agencies to apply, control, and manage automated behaviors of civilians in a simulated emergency situation, such as a chemical release. The enhancements were accomplished through integration of Defence Research Development Canada's CAMX tool with the popular training simulation software Virtual Battlespace 2 (VBS2) and the U.S. Naval Research Lab's CT Analyst tool. Developing emergency behavior enhancements in CAMX met the need to apply, control, and manage automated behaviors based on a simulated emergency situation while making CAMX a more robust tool.

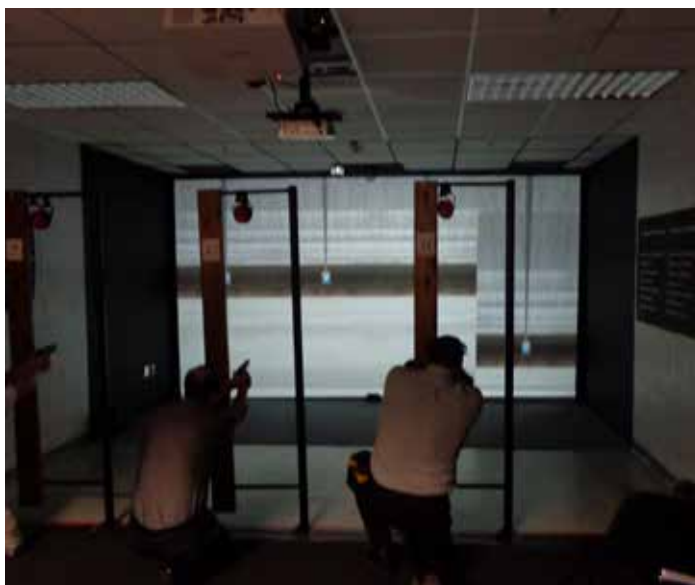


VBS2 model of live environment with CAMX crowd added.



CAMX crowd in VBS2 running from a threat source.

Marksmanship Simulation Capabilities Evaluation



Course of fire using simulated shooting technology.

The Training Technology Development (TTD) Subgroup worked with the Royal Canadian Mounted Police (RCMP) to complete a Marksmanship Simulation Evaluation at RCMP Academy, Depot Division. The one-week evaluation consisted of testing the accuracy, features, and functions of six different vendor shooting simulation systems. Skilled shooters from ten different United States and Canadian military and law enforcement organizations participated. These shooters tested each system by firing at simulated targets at various distances and from various positions according to an established course of fire. The focus was on pistol and carbine weapons. The evaluation report has been shared with over 15 different United States and Canadian agencies to date. The report allows law enforcement and military marksmanship simulation users to make educated decisions when selecting technology to optimize training and reduces the risk of purchasing an incongruent system, thereby saving time and money.

CURRENT PROJECTS

Low Cost Robotic Human Type Target

Conducting live fire on a moving target is often experienced for the first time during combat, instead of during training exercises. The Low Cost Robotic Human Type Target system addresses this training challenge by providing soldiers with realistic, robotic human type targets. Marathon Target's T40 target is an autonomous trackless target designed to replicate human size, movement, and behavior on the training range. The target system creates a realistic and dynamic tactical environment for the training of individual soldiers and collective formations in live fire marksmanship, advanced combat tactics, and dynamic tactical maneuvers.

Current users of the system are mainly Special Forces; however, there is a clear need for realistic marksmanship training for the wider military and law enforcement community. This project aims at developing a low-cost version of the T40 target, specialized for use cases by the broader marksmanship training community.



Marathon's current robotic human-type target (T40).



T40s used in the Infantry Basic Leadership Course (IBLC) at Ft. Benning.



Experiment to determine the most effective way of engaging human-type targets.

Mobile Security in Operational Environments

Mobile security news updates and practices are ever changing due to identification of new vulnerabilities and nearly constant updates to operating systems. Float Mobile Learning designed and developed an innovative and unique custom mobile training and performance support application for iOS and Android devices that provides up to date information on security news and turns the device itself into a powerful security assessment tool. The app provides mobile security education and device assessment tools to assist operational users in using their devices more safely. Current security news,





tips and tricks, and a diagnostic toolset to determine current threats all available on the mobile device will be combined to create a useful app for operational personnel.

Atlas Wearables Device Enhancements

Through the CTTSO innovation program, the Training Technology Development (TTD) Subgroup is working with In-Q-Tel to enhance a wearable device for tracking exercise and physiological data. The wrist-worn device, developed and being enhanced by Atlas Wearables, recognizes when the wearer is doing specific exercises using high fidelity sensor technology. The device comes pre-programmed with dozens of common exercises, but can also learn new exercises via a proprietary algorithm. Currently, the device tracks limited physiological data such as heart rate and caloric expenditure. The In-Q-Tel and CTTSO co-sponsored effort will enhance the device to track sleep duration, sleep quality, and skin temperature. The device will also be made water resistant for use when swimming and more ruggedized to withstand the demands of operational end users. The current technology features a mobile app and personal trainer dashboard; both will be enhanced for increased usability focused on the needs of the operational community. End users are from U.S. Special Operations Command and the Department of Homeland Security Customs and Border Protection.



Overhead view of the Atlas Wearables fitness tracker.

The device easily slides in and out of the band.



The fitness tracker records the number of reps and the weight of the dumbbells.



A view of the app that shows a user's overall progress.

Maritime Low Observables Identification Initiative

The Maritime Low Observable Identification Capability (M-LOIC) program is an enduring effort to design, develop, and implement maritime surveillance training and technology solutions for the DoD to identify and



defeat combatant networks operating in and around the maritime environment that pose a continued transnational threat to U.S. and partner nation forces abroad. The program commenced with detailed research and analysis to properly identify existing training and technology capability gaps to support maritime surveillance operations for the program

end user community. From these identified gaps, an iterative design process was used to develop multiple training courses that end users attended to properly evaluate each topic of instruction. The iterative design process supports building a comprehensive program of instruction for future integration into the end user's pre-deployment training cycle. The M-LOIC program is also dedicated to developing technological solutions to support maritime surveillance operations. These solutions are being developed to support low visibility operations for the end user on non-standard surface maritime mobility platforms. All research conducted throughout the program is ongoing to ensure continued operational relevance for the end user community in both training and technology supporting real world maritime surveillance operations.

NeuroTracker Operational Task Effectiveness Evaluation

The Training Technology Development Subgroup is working with the United States and Canadian Special Operations community as well as Defence Research and Development Canada to examine the effects of NeuroTracker training on operationally relevant outcomes in the psychological, physiological, and physical domains. NeuroTracker is a relatively recent training device that has been shown to improve dynamic attention and working memory amongst athletes and non-athletes by training 3D multiple object tracking skills. Lacking, however, is an evaluation of the system's effectiveness for improving operationally relevant task performance such as shooting accuracy, anticipatory attention in friend-foe identification, and memory for objects in a 3D space. This effort addresses that gap by evaluating NeuroTracker and providing critical information to end users both in Canada and the United States about the system's potential for optimizing human performance through training. The final evaluation report will be shared across the United States and Canadian government agencies to better inform them of NeuroTracker's training potential.

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European Police Office (Europol)

Intelligence Community

InterAgency Board

National Bomb Squad Commanders Advisory Board

National Tactical Officers Association

U.S. Agency for International Development

U.S. Department of Defense

- Advanced Distributed Learning Initiative
- Defense Intelligence Agency
- Joint Improvised-Threat Defeat Agency
- Office of the Under Secretary of Defense for Personnel and Readiness
- Pentagon Force Protection Agency
- U.S. Army Asymmetric Warfare Group

- U.S. Marine Corps
 - U.S. Marine Training and Education Command
- U.S. Special Operations Command
 - Air Force Special Operations Command
 - Army Special Operations Command
 - 75th Ranger Regiment
 - U.S. Army John F. Kennedy Special Warfare Center and School
- Marine Corps Forces Special Operations Command
- Naval Special Warfare Command

U.S. Department of Homeland Security

- Customs and Border Protection
- Federal Law Enforcement Training Center
- Homeland Security Investigations

- Immigration and Customs Enforcement
- Office for Bombing Prevention
- Science and Technology Directorate
- Transportation Security Administration
- U.S. Coast Guard
- U.S. Secret Service

U.S. Department of Justice

- Bureau of Alcohol, Tobacco, Firearms and Explosives
- Federal Bureau of Investigation
- Office of the Attorney General
- U.S. Marshals Service

U.S. Department of State

- Bureau of Counterterrorism
- Bureau of Diplomatic Security

U.S. Department of the Treasury

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 Leidos, Vista
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Georgia Tech Research Institute, Atlanta
 VELOXITI, Inc., Alpharetta

Illinois

Argonne National Laboratory, Argonne
 Float Mobile Learning, Morton
 University of Illinois at Urbana-Champaign, Champaign

Indiana

Purdue University, West Lafayette



Maryland

Army Communications-Electronics Research, Development and Engineering Center (CERDEC) Intelligence and Information Warfare Directorate (I2WD), Aberdeen Proving Ground

Army Research Laboratory, Aberdeen Proving Ground

Army Research Laboratory, Human Research and Engineering Directorate, Adelphi

Avon Protection Systems, Inc., Belcamp

Axom Technologies, Inc., Annapolis Junction

CyberReliant Corporation, Annapolis

Digital Infuzion, Inc., Gaithersburg

Edgewood Chemical Biological Center, Aberdeen Proving Ground

Efficio, Inc., Laurel

ELTA North America, Fulton

HP White Laboratory, Inc., Street

Intelligent Automation, Inc., Rockville

Johns Hopkins University Applied Physics Laboratory, Laurel

National Biodefense Analysis and Countermeasures Center, Frederick

Naval Surface Warfare Center, Explosive Ordnance Disposal Technology Division, Indian Head

Mistral, Inc., Bethesda

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Cybernet Systems Corporation, Ann Arbor

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Minnesota

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New Jersey

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Signature Science, Egg Harbor

Sterling Medical Devices, Rochelle Park

Transportation Security Laboratory, Egg Harbor

New Mexico

Applied Research Associates, Inc., Albuquerque

Energetic Materials Research and Testing Center, Socorro

National Assessment Group, Kirtland Air Force Base
Sandia National Laboratories, Albuquerque

New York

Cornell University, Ithaca
GE Global Research, Niskayuna
Intertek, Cortland
Lockheed Martin Mission Systems and Training, Owego
Persistent Systems, LLC, New York
SRC, Inc., Syracuse
Syracuse University, Syracuse

North Carolina

Advanced Mission Systems, Charlotte
Emerging Technology Support, LLC, Mooresville
Horizon Performance, LLC, Cary
North Carolina State University, Textile Protection and Comfort Center, Raleigh

Ohio

Battelle Memorial Institute, Columbus
Lion Apparel, Inc., Dayton
nVisti Tactical Innovation, Inc., Cleveland

Oregon

Thetus Corporation, Portland

Pennsylvania

Gentex Corporation, Simpson
Getting More, Inc., Philadelphia
Pennsylvania State University, State College
RE2, Inc., Pittsburgh
University of Pennsylvania, Philadelphia

Rhode Island

Naval Undersea Warfare Center, Newport

South Carolina

Department of Energy – Savannah River Operations Office, Aiken

Tennessee

eSpin Technologies, Inc., Chattanooga
Universal Strategy Group, Inc., Franklin

Texas

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Texas A&M University, College Station
University of Texas at Dallas, Richardson

Utah

ID Scientific, Park City
Operators Suppressor Systems, Salt Lake City
Torion Technologies, Inc., American Fork

Virginia

Adayana Government Group, Falls Church
ADI Technologies, Inc., McLean
Applied Research Associates, Inc., Arlington
AppTek, McLean
Battelle Memorial Institute, Arlington
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Raytheon Blackbird Technologies, Inc., Herndon
S4Tech, Inc., Sterling
Safety Equipment Institute, McLean
SDL Federal Solutions, Inc., Herndon
Segue Technologies, Inc., Arlington
Semantic Research, Inc., Arlington
Shoulder 2 Shoulder, Inc., Arlington
Silverback7, Inc., Woodbridge
System of Systems Analytics, Inc., Fairfax
SyTech Corporation, Alexandria
Threat Knowledge Group, LLC, McLean
VECTARE, Inc., Fairfax
Virginia Polytechnic Institute and State University, Blacksburg
White Canvas Group, LLC, Alexandria
ZTI Solutions, LLC, Arlington

Washington

Analytical Methods, Inc., Kirkland

Cascade Designs, Inc., Seattle
Pacific Northwest National Laboratory, Richland

West Virginia

Azimuth, Inc., Morgantown
EyeMarker Systems, Inc., Morgantown
West Virginia Army National Guard, Camp Dawson

Wyoming

Snowy Range Instruments, Laramie

Australia

Australian Emergency Management, Canberra, Australian Capital Territory
Australian Nuclear Science and Technology Organisation, Lucas Heights, New South Wales
Catapult Innovations, Scoresby, Victoria
ChemCentre, Bentley, Western Australia
Department of Prime Minister and Cabinet, Canberra
Defence Science and Technology Group, Canberra, Australian Capital Territory
Defence Science and Technology Group, Edinburgh, South Australia
Defence Science and Technology Group, Fisherman's Bend, Melbourne, Victoria
Flinders University, Adelaide, South Australia
Marathon Targets, Sydney, New South Wales
Queensland Fire and Emergency Services, Brisbane, Queensland
Queensland University of Technology, Brisbane, Queensland
Semantic Science Pty. Ltd., Stirling, South Australia
University of Adelaide, Adelaide, South Australia
University of Technology, Sydney, New South Wales

Canada

AirBoss Defense, Acton Vale, Quebec
Canadian Border Services Agency, Ottawa, Ontario
Canadian Commercial Corporation, Ottawa, Ontario

Defence Research and Development Canada, Suffield, Alberta

Defence Research and Development Canada, Valcartier, Quebec

Ottawa Fire Services, Ottawa, Ontario

Public Health Agency of Canada, Winnipeg, Manitoba

Pyrogenesis Canada, Inc., Montreal, Quebec

Royal Canadian Mounted Police, Ottawa, Ontario

The SecDev Group, Ottawa, Ontario

Toronto Police Service, Toronto, Ontario

Transport Canada, Ottawa, Ontario

Uncharted Software, Inc., Toronto, Ontario

Germany

University of Bonn, Bonn

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Israel Defense Forces

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Netherlands Organisation for Applied Scientific Research, Delft

New Zealand

ikeGPS, Ltd., Wellington

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SensePost Pty. Ltd., Pretoria

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Saab Seaeye, Ltd., Linköping

United Kingdom

Buckler Davies Consultancy, Ltd., Swindon

Centre for the Protection of National Infrastructure

Cobalt Light Systems, Ltd., Abingdon

Defence Science and Technology Laboratory, Fort Halstead

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Landguard Systems, Ltd., Fareham

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Ministry of Defence, London

New Century Consulting, London

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BAA INFORMATION DELIVERY SYSTEM (BIDS)

The Broad Agency Announcement (BAA) Information Delivery System, better known as BIDS, works to support the CTTSO mission through the electronic publication of its annual BAA. BAAs are the solicitation method of choice to bring the most urgent combating terrorism requirements forward for publication. CTTSO staff monitors BAA package instruction in light of submitter responses and feedback, and CTTSO implements improvements as needed each year to clarify the submission process.

To ensure the widest possible distribution to potential submitters, BAAs can be downloaded at the BIDS website (<http://bids.cttso.gov>) and are also advertised at the Federal Business Opportunities website (<http://www.fedbizopps.gov>). In addition to conventional government solicitation notices, the BIDS website provides a BIDS Advisory and Announcements page that posts BAA news, coming events, and partnering agency solicitations. In addition to the advisory, the RSS (really simple syndication) news feed allows interested users to receive real-time broadcast information at a local computer when connected to the Internet.

BIDS is good source of information for submitters, providing helpful links for working with the government, online help, and guidance for offerors proposing the use of Human Subjects in research. Summary BAA statistics are posted once the BAA is finished.

BIDS not only functions as a response collection system, but also provides submission evaluation and submitter notification. Submitter data is fully protected in a 128-bit encrypted environment. Evaluators must comply with source selection data handling requirements and accept a nondisclosure agreement to access BIDS. In addition to the nondisclosure, evaluators must also certify that no conflict of interest exists before access is granted to any submissions. The evaluation process is monitored for timely notice to submitters with the typical response via an automated e-notice to complete within 90 days.

BIDS continues to serve as a leading solicitation process model for other federal programs by providing a streamlined electronic solution to receive proposals, providing access for subject matter expert evaluation, processing submissions through the approving authority, notifying the submitter of status, and maintaining a record of solicitation results.



